IN THE UNITED STATES PATENT & TRADEMARK OFFICE

BEFORE THE BOARD OF APPEALS

In Re Application of:

Applicants:	Richard R. Haws et al.
Appl. No.:	09/589,758
Filed:	06/09/2000
Title:	AUTOMATIC ADAPTIVE DIMENSIONING FOR CAD SOFTWARE
Group:	
Examiner:	FERRIS III, FRED O.
Customer No.:	1059
Docket No.:	13999-1/SDJ

January 25, 2005

APPEAL BRIEF

On November 26, 2004, the Applicants appealed from the rejection of claims 7 to 18 in this application. No claims have been allowed. The following is the Appeal Brief required by 37 CFR 41.37.

(1) Real Party in Interest

The real parties in interest are the applicants, Richard R. Haws and Robert Nicolucci.

(2) Related Appeals and Interferences

None.

(3) Status of Claims

Claims 1 to 6 were initially presented in this application. Claims 1 to 6 were cancelled, and claims 7 to 18 were introduced in a response filed June 3, 2004. All claims have been rejected.

In accordance with 37 CFR 41.33(b)(1), claim 7 is hereby cancelled without prejudice.

In accordance with 37 CFR 41.33(b)(2), claim 8 has been amended herein to rewrite it in independent form to include the limitations of claim 7.

The claims being appealed are claims 8 to 18. A copy of the appealed claims as amended appears in the Claims Appendix.

(4) Status of Amendments

Other than the cancellation of claim 7 and rewriting of claim 8 in independent form, herein, no amendments have been filed subsequent to Final Rejection.

(5) Summary of Claimed Subject Matter

The invention which is the subject of the present application relates to methods for creating computer aided design (CAD) drawings. Certain types of drawings, such as architectural drawings, in their final version often require the display of dimension annotations corresponding to the different objects (such as

walls or windows, for example) in the drawing. A dimension annotation indicates the dimension of the corresponding object.

As set out in greater detail with respect to specific claims, the inventors developed an improved CAD method which provides for accurate dimension annotations as the drawing is created and modified. When an object is created (by inputting coordinate position data) in a drawing made in accordance with the subject invention, a corresponding dimension annotation is also created which is cross-associated to the object. As a result of such cross-association, (a) if the dimension annotation is changed, the object (via the coordinate position data) is correspondingly changed and, (b) if the object is changed (via changes to the coordinate position data), the dimension annotation is correspondingly changed.

The elements of the claims, together with pinpoint references to the specfication, are set out below:

__Claim 8__

The invention defined in claim 8 relates to a method for creating a computer aided design drawing formed of a plurality of target objects. The steps of the method include:

(a) inputting first coordinate position data;

Page 6, Line 18; Page 7 Lines 13 to 15 & Figure 2

(b) displaying a first target object corresponding to the first coordinate position data;

Page 7 Lines 13 to 15 & Figure 2

(c) creating first dimension annotation data correlated to the first coordinate position data;

Page 7 Lines 15 to 19 & Figure 2

(d) displaying a first dimension annotation correlated to the first dimension annotation data; and

Page 7 Lines 15 to 19 & Figure 2

(e) cross-associating the first target object with the first dimension annotation, wherein as a result of such cross-association:

(i) a change in the first coordinate position data will effect a correlated change in the first dimension annotation data; and

Page 2 Lines 14 to 18

(ii) a change in the first dimension annotation data will effect a correlated change in the first coordinate position data.

Page 2 Lines 14 to 18

(f) subsequent to step (e), inputting further coordinate position data corresponding to at least one further target object;

Page 7 Lines 20 to 21 & Figure 3

(g) displaying the further target object in accordance with the further coordinate position data;

Page 7 Lines 20 to 21 & Figure 3

(h) creating further dimension annotation data correlated to the further coordinate position data;

Page 7 Lines 21 to 25 & Figure 3

(i) displaying a further dimension annotation correlated to the further dimension annotation data

Page 7 Lines 21 to 25 & Figure 3

(j) cross-associating the at least one further target object with the further dimension annotation, wherein as a result of such cross-association:

(i) a change in the further coordinate position data will effect a correlated change in the further dimension annotation data; and

Page 2 Lines 14 to 18

(ii) a change in the further dimension annotation data will effect a correlated change in the further coordinate position data;

Page 2 Lines 14 to 18

As set out above, claim 8 includes in step (e), cross-associating the first target object with the first dimension annotation, wherein as a result of such cross-association: (i) a change in the first coordinate position data will effect a correlated change in the first dimension annotation data; and (ii) a change in the first dimension annotation data will effect a correlated change in the first coordinate position data.

One of the advantages of cross-associating each object with its corresponding dimension annotation is that the accuracy of each dimension annotation with respect to its object is maintained. Any modification to one, will promptly effect a corresponding modification to the other.

Claim 8 also includes the limitation that the steps of inputting and displaying a first target object and creating and displaying a corresponding dimension annotation and creating a cross-association (steps (a) to (e)) are completed **prior to inputting another target object** (referred to herein throughout as the "timing limitation"). This timing limitation, in combination with the cross-association identified in element (e) ensures that an image is accurately dimensioned throughout its development, as each object is added to the image and as modifications are made.

None of the cited art teaches or suggests such functionality or provides the resulting accuracy advantages of the claimed invention.

Claim 13

The invention defined in claim 13 relates to a method for creating a computer aided design drawing formed of a plurality of target objects, comprising the steps of:

(a) inputting coordinate position data for a new target object;

Page 6, Line 18; Page 7 Lines 13 to 15 & Figure 2

(b) displaying the new target object corresponding to the coordinate position data;

Page 7 Lines 13 to 15 & Figure 2

(c) creating dimension annotation data correlated to the coordinate position data;

Page 7 Lines 15 to 19 & Figure 2

(d) displaying a dimension annotation correlated to the dimension annotation data;

Page 7 Lines 15 to 19 & Figure 2

(e) cross-associating the new target object with the dimension annotation, wherein in said cross-association:

(i) a change in the coordinate position data will effect a correlated change in the dimension annotation data; and

Page 2 Lines 14 to 18

(ii) a change in the dimension annotation data will effect a correlated change in the coordinate position data;

Page 2 Lines 14 to 18

(f) repeating steps (a) through (e) for at least one additional target object;

Page 7 Lines 20 to 25 & Figure 3

(g) wherein all of steps (a) through (e) are completed for one target object prior to inputting coordinate position data for any additional target object.

Page 2 Lines 14 to 18

Claim 13 also contains the cross-association limitation, together with the limitation that the steps of inputting and displaying a first target object and creating and displaying a corresponding dimension annotation and creating a cross-association (steps (a) to (e) in claim 13) are completed **prior to inputting another target object**. This timing limitation (limitation (g) in claim 13), in combination with the cross-association identified in element (e) of claim 13 ensures that an image is accurately dimensioned throughout its development, as each object is added to the image and as modifications are made.

None of the cited art teaches or suggests such functionality or provides the resulting continuous accuracy advantages of the claimed invention.

(6) Grounds of rejection to be reviewed on appeal

Rejections under 35 U.S.C. 112(1)

In the Final Action dated August 27, 2004, claims 7-18 were rejected under 35 U.S.C. 112(1) "for lack of an adequate written description". For reasons noted below, it is submitted that the written description is adequate and fully supports the claimed invention.

Rejections under 35 U.S.C. 102(a)

In the Final Action, claims 7-18 were rejected under 35 U.S.C. 102(a) as being clearly anticipated by the publication "ArchiTECH.PC v. 3.0 joins the object

revolution". For reasons noted below, it is submitted that the claimed invention is neither obvious nor anticipated by the cited article, nor any of the other references cited by the Examiner.

Rejections under 35 U.S.C. 103(a)

In the Final Action, claims 7-18 were rejected under 35 U.S.C. 103(a) as being unpatentable over the publication "AutoCAD User's Guide", Release 14 in view of the publication "Automatic Dimensioning in Design for Manufacturing". For reasons noted below, it is submitted that the claimed invention is not obvious in view of the combination of the cited articles, nor any of the other references cited by the Examiner.

(7) Argument

The applicants maintain their arguments previously submitted in the Amendment filed June 3, 2004, in response to the Examiner's first office action (the "Original Office Action").

Rejections under 35 U.S.C. 112(1)

As noted, in the Final Action dated August 27, 2004, claims 7-18 were rejected under 35 U.S.C. 112(1).

In the response dated June 3, 2004, the Applicants filed Affidavits in support of their submissions that the specification is enabling. One of the Affiants, Professor Desmond Walton, is a very experienced computer science professor from the University of Manitoba. The second affiant, David Borean, is a programmer who at the request of one of the applicants was able to produce

software described in the specification and claimed in the pending claims, prior to the filing date of the application.

Specifically, the Examiner has indicated that the Affidavits from Professor Desmond Walton and Mr. David Borean in support of the submissions that the specification is enabling, are non-persuasive as they "provide no indication of how a skilled artisan ... would actually implement the claimed subject matter based on the information provided in the specification." Mr. Borean's Affidavit was rejected as unpersuasive as he does not indicate "where in the specification [the] steps or diagrams [described and shown to him] are recited or how they were used to implement the claimed subject matter." [emphasis in the original]

In support of the Examiner's conclusion, the Examiner has cited MPEP s.2100 as follows:

> For a computer-related invention, the disclosure must enable a skilled artisan to configure the computer to possess the requisite functionality, and, where applicable, **interrelate the computer with other elements to yield the claimed invention,** without the exercise of undue experimentation. The specification should disclose **how** to configure a computer to possess the requisite functionality or **how** to integrate the programmed computer with other elements of the invention, unless a skilled artisan would know how to do so without such disclosure. See, eg. Dossel, 115 F.3d at 946-47, 42 USPQ2d at 1884-85; Northern Telecom v. Datapoint Corp., 908 F.2d 931, 941-43, 15 USPQ2d 1321, 1328-30 (Fed. Cir. 1990). [emphasis in the original]

It is submitted that the Examiner's conclusions are unfounded. The Examiner has repeated the bald assertions from his first office action that the disclosure is not enabling. These assertions flatly contradict the evidence

provided by two skilled artisans that the disclosure is and was enabling. The Examiner's position is itself "merely conclusory", and unsupported.

The Examiner has simply taken the position that the specification and the affidavits filed " ... are completely silent on the specifics of how the claimed invention would interact (ie. interface) with an existing CAD program to, for example, "automatically" generate the adaptive dimensioning features as noted throughout the specification on pages 6-9."

With respect, in reaching his conclusions, and in reciting s.2100 of the MPEP the Examiner has misread the above-quoted MPEP section. As clearly set out in the quoted passage, "the disclosure must enable a skilled artisan to configure the computer to possess the required functionality, and, **where applicable**, interrelate the computer with other elements to yield the claimed invention, **without the exercise of undue experimentation.** ... **unless a skilled artisan would know how to do so without such disclosure.**" (emphasis added)

The Examiner has provided no basis for concluding that a skilled artisan would require details about interfacing with an existing CAD program as one possible option for implementing the claimed invention. In fact, such a conclusion flies directly in the face of the evidence provided in the Walton and Borean Affidavits, discussed in greater detail, below.

As set out in his Affidavit, the Professor reviewed the application and the Original and Amended Claims (the current pending claims) and has concluded that the specification is sufficient. In paragraphs 14, 15 and again in paragraph 17, Prof. Walton states that:

14. In my view, as of June 9, 2000, **the description of the technology in the patent application is and was sufficiently full and complete, clear and concise to enable the programming and use of software capable of**

performing the methods as claimed in both the Original Claims and the Amended Claims. While programming typically requires routine debugging, **no undue or unreasonable experimentation would be needed to reproduce the technology described in the application.**

15. It should be understood that it is not typically required to provide excessively detailed information about a software program, in order for another programmer to reproduce it. **In many cases, providing the functionality, or the way the software performs, is sufficient. The present patent application clearly describes the features and functions of the software as defined in the Original and Amended Claims, sufficiently for another programmer to reproduce and use it.**

17. Based on my experience as a professor, I am well aware of the skills and abilities of computer science students within our department. I am specifically of the view that as of June 9, 2000, **computer science students at the University of Manitoba during or at the completion of the third year of their Bachelor's degree (typically a four year program), upon reading the patent application would be able to program and use the software as claimed in the Original and Amended Claims**, without needing to obtain additional information from the inventors and without unreasonable experimentation. **[emphasis added]**

It is worth noting that the Professor's statement in para. 15 of his affidavit that "it is not typically required to provide excessively detailed information about a software program, in order for another programmer to reproduce it", is echoed in the *Fonar* case as set out in the MPEP s. 2163(I)(A):

> As a general rule, where software constitutes part of a best mode of carrying out an invention, description of such a best mode is satisfied by a disclosure of the **functions** of the software. **This is because, normally, writing code for such software is within the skill of the art, not requiring undue experimentation, once its functions have been disclosed. ... Thus, flow charts or source code listings are not a requirement for adequately disclosing the functions of software.**

Fonar Corp. v. *General Electric Co.*, 107 F.3d 1543, 1549, 41 USPQ2d 1801, 1805 (Fed. Cir. 1997) (emphasis added)

In the Final Action, the Examiner has acknowledged that the "specification appears as...features that are to be 'automatically' generated". As well, the Examiner has conceded that the Figures in the specification "depict the output of the claimed subject matter". This would appear to be consistent with the general test for sufficiency of software disclosures in the *Fonar* decision set out above.

The Professor's conclusion that the specification provides sufficient support for a programmer to make and use the technology claimed in the pending claims is further supported by the Affidavit of David Borean.

Mr. Borean states that his programming "... work on the Software Application was routine and straightforward. Upon completion, the Software Application provided the desired Automatic Adaptive Dimensioning functionality." (para. 10). Mr. Boreans "was able to complete the programming within the estimate of 160 hours of development work" (para 10). Furthermore, Mr. Borean recollected that the "patent application clearly describes the Automatic Adaptive Dimensioning method and technology, which is claimed in the Original and Amended Claims, and is consistent both in terms of scope and content with the information Mr. Haws provided to [Mr. Boreans] in February of 2000." (para. 17)

In his view, "... as of June 9, 2000, the description of the technology in the patent application is and was sufficiently full and complete, clear and concise to enable [him] or any competent programmer to program and use software capable of performing the methods as claimed in both the Original Claims and the Amended Claims. ... [His] programming of the Software Application was straightforward and did not require any undue or unreasonable experimentation." (paras. 19 & 21)

Following the *Wertheim* and *Smith* decisions, section 2163(II)(A) of the MPEP provides that a s.112 rejection should be very rare, in view of a strong presumption that the description is enabling:

> There is a **strong presumption** that an adequate written description of the claimed invention is present in the specification as filed." (See *Wertheim*, 541 F.2d at 262, 191 USPQ at 96) ... Consequently, rejection of an original claim for lack of written description should be rare. (See *In re Smith*, 458 F.2d 1389, 1395, 173 USPQ 679, 683 (CCPA 1972) (emphasis added)

The Examiner has failed to provide any basis for rejecting the clear and unequivocal factual evidence of Prof. Walton and Mr. Borean to the effect that a skilled artisan would be able to duplicate the claimed invention upon reading the specification, without undue experimentation. This is the test set out in s.2100 of the MPEP. It is submitted that the Examiner has failed to overcome the strong presumption that the specification is sufficient.

The Examiner's conclusion in this regard seems particularly surprising in view of the fact that as set out in his affidavit, Mr. Borean actually developed software possessing the requisite functionality of the claimed invention. The software Mr. Borean developed was based on information consistent in scope and content with that disclosed in the specification. In summary, the Examiner appears to have taken the position that the claimed invention could not be replicated (without undue experimentation) by a skilled artisan upon reading the specification. Mr. Borean's Affidavit very clearly indicated that not only could it be replicated, it was in fact replicated.

Furthermore, as set out in s.2106(V)(B)(2) of the MPEP, the decision of *DeGeorge* clearly established that a finding of invalidity under s.112 is to be reversed as a **clear error** in the face of expert testimony showing:

> ... that a programmer of reasonable skill could write a satisfactory program with ordinary effort based on the disclosure; *DeGeorge* v. *Bernier*, 768 F.2d 1318, 1324, 226 USPQ 758, 762-63 (Fed. Cir. 1985)

In the face of evidence that a skilled artisan was in fact able to duplicate the invention based on information comparable to that contained in the specification and without undue experimentation, it is submitted that a heavy onus lies on the Examiner to support a contrary conclusion that a skilled artisan could not duplicate the claimed invention based on the specification. It is submitted that the Examiner has failed to meet this onus.

Section 2106.01 of the MPEP provides that an Examiner must provide a reasonable basis for rejections based on s.112:

> When basing a rejection on the failure of the applicant's disclosure to meet the enablement provisions of the first paragraph of 35 U.S.C. 112, the examiner must establish on the record that he or she has a reasonable basis for questioning the adequacy of the disclosure to enable a person of ordinary skill in the art to make and use the claimed invention without resorting to *undue experimentation*. See *In re Brown*, 477 F.2d 946, 177 USPQ 691 (CCPA 1973); *In re Ghiron*, 442 F.2d 985, 169 USPQ 723 (CCPA 1971) (emphasis in original)

Again, with respect, it is submitted that the Examiner has failed to provide such a reasonable basis for his s.112 rejection, particularly in view of the Affidavit evidence submitted by the Applicant.

Furthermore, it is submitted that the Examiner's conclusions pursuant to s.112 are directly contradicted by his formulation of a claim interpretation and by his arguments pursuant to ss. 102 and 103. The Examiner has concluded that the claimed invention is both "**clearly** anticipated by the publication *ArchiTECH.PC v. 3.0 joins the object revolution*, and obvious in view of "AutoCAD User's Guide", Release 14 together with "*Automatic Dimensioning in Design for Manufacturing*".

On the one hand, the Examiner has taken the position that the claimed invention cannot be understood and duplicated from the specification. On the other hand, the Examiner has concluded that the claimed invention has either

been "done" before, or was obvious to "do" in view of the cited art. With respect, the Examiner is effectively "sucking" and "blowing" at the same time. With respect, the Examiner's positions are logically irreconcilable.

The Examiner appears to be using different standards in reaching conclusions about sufficiency of the application's disclosure as compared to the sufficiency of disclosure of cited art references.

For example, as discussed below, the Examiner has cited the publication *ArchiTECH.PC V.3.0* by Goldberg as anticipating the claimed invention. However, nowhere does Goldberg disclose any "algorithms, flowcharts, or techniques for actually generating dimensions, cross-associating target objects, setting parameters, or calculating coordinates" (emphasis in the original), which the Examiner lists as an example of why the present disclosure is insufficient. Similarly, the Examiner has stated that the AutoCAD User's Guide, Release 14 teaches "all of the features required to facilitate automatic modification of an object's length/position based on a modified dimension annotation (or *vice versa*)", in support of his conclusions regarding obviousness.

With respect, it is inappropriate for the Examiner to utilize one standard with respect to what one skilled in the art would be able to understand for the purposes of his s.112 analysis, and utilize a completely different standard for the purposes of ss.102 and 103 analysis. The same standard that the Examiner has used for ss.102 and 103 analysis regarding the notional "skilled worker" should be applied to his analysis for s.112 purposes.

For the above-noted reasons, it is submitted that the Examiner's conclusions and rejection pursuant to s.112 are unfounded and should be overturned on appeal.

Claim Rejections – 35 U.S.C. 102

Claims 7 - 18 have been rejected, pursuant to 35 U.S.C. 102(b), as being anticipated by the publication *ArchiTECH.PC V.3.0* by Goldberg.

Regarding claims 8 & 13, the Examiner states that the Goldberg publication teaches:

(a) inputting coordinate position data (Figs. 2,4,6, page 2 (all), page 3 (section entitled "Dimensioning"), page 4 (list of Features)).

(b) displaying target object corresponding to coordinate data (Figs. 1 & 2, page 1 (para. 1), page 2 (para. 2), page 3 (sections entitled "Library objects" and "Sectioning tool", page 4 (all)).

(c) creating the dimension annotation data relative to coordinate position data (Figs. 1-6, page 1 (para. 1), page 2 (para. 2), page 3 (sections entitled "Library objects" and "Sectioning tool", page 4 (all)).

(d) displaying dimension annotation correlated to dimension annotation data ((Figs. 1-6, page 1 (para. 1), page 2 (all), page 3 (sections entitled "Library objects" and "Sectioning tool", page 4 (all)).

(e) cross-associating the target object dimension annotation where a change in coordinate position data will effect (show) the change in dimension annotation data, and a change in the dimension annotation data will effect (show) a correlated change in coordinate position data (Figs. 1 & 2, page 1 (para. 1), page 2 (para. 2 and section entitled "Dimensioning"), page 4 (all)).

(f) & (g) repeating steps (a) through (e) for additional objects **(prior to input)**.

With respect to elements (f) & (g), the Examiner has taken the position that "[t]his feature would obviously be inherent in the prior art since any CAD system would need to repeat the processing of steps (a) to (g) in order to accommodate additional objects. Otherwise, the system could not operate on multiple drawing objects." As will be discussed in greater detail below, this conclusion is incorrect

as Goldberg does not teach the repetition of steps (a) to (e), **prior to input** of any additional object. Neither is this limitation inherent in Goldberg.

The Examiner has also concluded that claims 9-12 and 14-18 (which depend from claims 8 or 13) "merely [include] additional limitations relating to processing additional (further) target objects and modifying (updating) relative dimensions using equivalent steps to those recited in the independent claims, and detecting if a target object intersects with further adjacent target objects", which are taught by Goldberg.

It is respectfully submitted for the reasons set out below that the Examiner's conclusions pursuant to s.102 are unfounded and should be overturned.

Claim 8 (s.102)

With respect to claim 8, this claim introduces the limitation (in step (f)) that the steps of inputting and displaying a first target object and creating and displaying a corresponding dimension annotation and creating a cross-association (steps (a) to (e)) are completed **prior to inputting another target object**, which in turn is then cross-associated. This functionality, in combination with the cross-association identified in element (e) ensures that an image is accurately dimensioned throughout its development, as each object is added to the image and as modifications are made.

Goldberg does not teach or suggest that the steps of (a) through (e), including the cross-association of the target object with the dimension annotation for one target object are completed prior to inputting an additional target object. The Examiner's assertion to the contrary, namely that "[t]his feature would obviously be inherent in the prior art since any CAD system would need to repeat

the processing of steps (a) to (g) in order to accommodate additional objects", is completely unfounded.

As set out in MPEP 2131.01I, a finding that a limtation is inherent in a cited reference must be supported by evidence:

> Such evidence must make clear that the missing descriptive matter is **necessarily present** in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *Continental Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991)

In this regard, the Examiner has provided **no** evidence that the claimed timing limitation is inherent in Goldberg. The Examiner has merely made a bald allegation that the limitation is inherent in Goldberg. In fact, as noted below, the Goldberg reference teaches away from the claimed timing limitation.

Nothing in the Goldberg article suggests that associating the dimension to the object is to be completed for an object, prior to inputting another object. In fact, Goldberg teaches **away** from this timing limitation. If this cross-association step was effected by the Goldberg system for each object as each object was entered, there would be no need for the user to need to perform the additional steps of "clicking on the wall, then clicking once more to place the dimension lines" (p.3, Dimensioning section). This description from Goldberg clearly indicates that only those objects which the user designates are associated, and only when the user so designates them.

In other words, Goldberg **does not** teach completing steps (a) to (e) **prior to inputting another target object**, as required in claim 8. Neither is this timing limitation inherent in Goldberg.

The test for anticipation is set out in *Verdegal Bros.* and *Richardson* cases, as identified in MPEP s.2131:

> "A claim is anticipated **only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference**." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). ... "The **identical invention must be shown in as complete detail as is contained in the ... claim** ." *Richardson v. Suzuki Motor Co.,* 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). (emphasis added)

It is submitted that the Examiner has failed to meet this test. As noted, since neither Goldberg nor any of the other references cited by the Examiner have taught or suggested the claimed timing limitation, a finding of anticipation cannot be supported.

Accordingly, it is respectfully submitted that the subject matter of claim 8 and all claims dependent thereon (claims 9 - 12) are neither anticipated by nor obvious in view of the Goldberg article.

Claim 13 (s.102)

With respect to elements (f) & (g), as noted above, Goldberg does not teach or suggest that the steps of (a) through (e), including the cross-association of the target object with the dimension annotation for one target object are completed prior to inputting an additional target object. The Examiner's assertion to the contrary, namely that "[t]his feature would obviously be inherent in the prior art since any CAD system would need to repeat the processing of steps (a) to (g) in order to accommodate additional objects", is completely unfounded.

This functionality, in combination with the cross-association identified in element (e) ensures that a drawing is completely and accurately dimensioned throughout its development, as each object is added to the drawing and as modifications are made.

None of the art cited by the Examiner teaches or suggests such functionality or provides the resulting accuracy advantages of the claimed

invention. Specifically, Goldberg teaches the creation of dimension annotations only upon the request of the user. As set out in the first paragraph of the "Dimensioning" section in Goldberg, "[y]ou autodimension walls, windows and doors by clicking on the wall, then clicking once more to place the dimension lines".

Nothing in the Goldberg article suggests that associating the dimension to the object is to be completed for each object, prior to inputting another object. If as suggested by the Examiner, this step was effected by the system for each object as each object was entered, there would be no need for the user to perform the additional steps of "clicking on the wall, then clicking once more to place the dimension lines". This passage clearly indicates that only those objects which the user intentionally designates are associated, and only <u>when</u> the user so designates them.

The Examiner's assertion that the Goldberg system would need such functionality, or else "the system could not operate on multiple drawing objects", is baseless. The Goldberg system could operate on multiple drawing objects, but any type of association of dimension annotations to objects would not be done in the order specified in the claimed invention. As a result, Goldberg would not provide the accuracy and other advantages that the present invention offers, as discussed above.

The timing limitations found in elements (f) & (g) are neither taught nor suggested by Goldberg and are by no means implicit therein as suggested by the Examiner. As a result, the test for anticipation set out above has not been met. Accordingly, it is respectfully submitted that the subject matter of claim 13 and all claims dependent thereon (claims 14 - 18) are neither anticipated by nor obvious in view of the Goldberg article.

<u>Claim Rejections – 35 U.S.C. 103</u>

The Examiner has rejected claims 7-18 under 35 U.S.C. 103(a) as being unpatentable over the publication "AutoCAD User's Guide", Release 14 in view of the publication "Automatic Dimensioning in Design for Manufacturing" by Serrano.

The Examiner has also rejected the claimed limitations as "amount[ing] to mere automation of a manual (AutoCAD) process using well-known parametric modeling techniques, which is obvious in view of the prior art of record".

The Examiner states that the AutoCAD guide teaches a CAD drawing system providing the first four steps of the claimed invention (as "would be found in nearly any commercially available CAD (AutoCAD, SolidWorks, SolidView/Pro, ProEngineer, etc.) program"):

(a) inputting coordinate position data (pp. 331-334, 397-401, 413-415, 405-409, 738,364-381).
(b) displaying target object corresponding to coordinate data (pp. 162-172, 242, 272).
(c) creating the dimension annotation data relative to coordinate position data (pp. 401-414, 364, 366).
(d) displaying dimension annotation correlated to dimension annotation data (pp. 162-172, 242, 272).

The Examiner further states that the Serrano article teaches automatic dimensioning in CAD systems and shows:

(e) cross-associating the target object dimension annotation where a change in coordinate position data will effect (show) the change in dimension annotation data, and a change in the dimension annotation data will effect (show) a correlated change in coordinate position data (Abstract, Sections: 1.0, 2.3, 3.0-3.2, Figs. 9-12).

(f) & (g) repeating steps (a) through (e) for additional objects (prior to input). In support, the Examiner states that this "step would be obvious (and necessary) otherwise the system would not be capable of processing additional (multiple) objects.

For reasons noted below, it is submitted that the claimed invention is not obvious in view of the combination of the cited references.

With respect to the cross-association limitation of element (e), as noted, the Examiner has suggested that Serrano teaches such a cross-association. With respect, the applicants disagree with this interpretation of Serrano. At most, the concept of a uni-directional association between dimension entities and corresponding objects may be inferred from Serrano, but even this is not entirely clear. It certainly cannot be fairly said that Serrano teaches bi-directional cross-association required by the claims.

Serrano discusses constraining characteristic points of an object "by a set of nonlinear equations derived from the dimensioning scheme" (s.2.1, 1st para) While Serrano contemplates changes being "made [to] his/her drawing" (s.2.1, 1st para), nowhere in Serrano does he explicitly discuss how such changes are effected. As a result, the Examiner's interpretation that Serrano teaches the claimed cross-association is not based on the teaching in the article, but is simply a "reading in" which is unsupported by the actual document. Accordingly, claims 8 and 13 and all claims which depend therefrom (claims 9-12, 14-18) are neither taught nor obvious in view of the cited articles.

Furthermore, the Examiner's assertion that the Serrano system would need the timing limitation, or else "the system could not operate on multiple drawing objects", is unfounded. To the contrary, Serrano in fact teaches away from this claim limitation.

Serrano explicitly contemplates systems in which "the geometric parts must be correctly dimensioned [before manipulation]. Computational tools at this stage will be extremely valuable to the designer, not only as a means to completely dimension an **undimensioned component** but to complete a **partially dimensioned** object conserving the designers intent" (emphasis added) (s.1.0, 3rd para.). Accordingly, it is clear that the systems contemplated by Serrano have not ensured that each object is cross-associated, **prior to entering a new object**, contrary to the Examiner's assertion (otherwise, there could be no "undimensioned" or "partially dimensioned" objects or components). The timing limitations found in elements (f) & (g) are neither taught nor suggested by Serrano, and are by no means implicit therein as suggested by the Examiner. Accordingly, the Examiner's suggestion that this timing limitation is implicit or obvious in Serrano amounts to mere hindsight reconstruction based on the applicant's disclosure, which is impermissible.

> The tendency to resort to "hindsight" based upon applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, **impermissible hindsight must be avoided** and the legal conclusion must be reached on the basis of the facts gleaned from the prior art. MPEP s.2142 (emphasis added)

This well-established principle has also been stated in the *Hodosh* decision, as referenced in MPEP 2141:

> ...The references must be viewed **without the benefit of impermissible hindsight vision** afforded by the claimed invention... *Hodosh v. Block Drug Co., Inc.*, 786 F.2d 1136, 1143 n.5, 229 USPQ 182, 187 n.5 (Fed. Cir. 1986) (emphasis added)

As restated in MPEP s.2142, the test for establishing a *prima facie* case of obviousness was set out in the decision of *In re Vaeck*:

> ...Finally, the prior art reference (or references when combined) must teach or suggest **all** the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success **must both be found in the prior art, and not based on applicant's disclosure**. *In re Vaeck,* 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991) (emphasis added)

This clear principle is again restated in the *Royka, Wilson* and *Fine* decisions, as set out in MPEP s. 2143.03:

> To establish *prima facie* obviousness of a claimed invention, **all the claim limitations must be taught or suggested by the prior art**. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "**All words in a claim must be considered in judeging the patentability of that claim agains the prior art**." *In re Wilson,* 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)

It is submitted that the Examiner has failed to meet this test as none of the references cited by the Examiner in the Original or Final Office Actions teach or suggest the claimed timing limitation. Absent the teaching or suggestion of this claim limitation, a finding of obviousness cannot be supported. Accordingly, it is respectfully submitted that the subject matter of claims 8 and 13 and all claims dependent thereon (claims 9-12, 14 - 18) are neither anticipated by nor obvious in view of the Serrano article.

Furthermore, the Examiner's statement that the claimed limitations "amount to mere automation of a manual (AutoCAD) process using well-known parametric modeling techniques, which is obvious in view of the prior art of record" is completely unfounded. None of the art cited by the Examiner and outlining parametric techniques dealt with the step of including dimension annotations to a drawing. Those articles simply discuss different ways of modeling geometry, and the rules that may be applied, for relating one object to another. The mere fact that the term "dimensioning" is used, for example in Serrano's article on p.381, s.2.2, does not indicate that Serrano has addressed the concept of dimension annotations in the context of the present application. None of the figures in Serrano (or any of the other cited parametric articles) illustrate dimension annotations.

As well, the Examiner has provided no justification for suggesting that the timing limitation of performing the cross-association **prior to entering a new**

object discussed above and set out in claims 8 and 13, has ever been performed manually. As previously stated, none of the references cited by the Examiner teach or even suggest such a limitation. Accordingly, the Examiner's conclusion that the invention claimed in claims 8 and 13 (and the claims that depend therefrom) amounts to the mere automation of a manual process is completely unfounded.

It is respectfully submitted that the subject matter of claims 8 and 13 and all claims dependent thereon (claims 9-12, 14 - 18) are neither anticipated by nor obvious in view of the Serrano article or any of the other parametric articles cited by the Examiner.

Summary

In the present case, the Examiner has failed to provide any basis for rejecting the clear and unequivocal factual evidence in the filed Affidavits that a skilled artisan would be able to duplicate the claimed invention upon reading the specification, without undue experimentation. This is the test set out in s.2100 of the MPEP. It is therefore submitted that the Examiner's conclusions with respect to s.112 are unfounded and should be overturned.

Furthermore, it is submitted that the Examiner has not provided and there does not appear to be any reason why one of ordinary skill in the art would have been led to provide the methods as claimed by the Applicants in the rejected claims, other than with a hindsight teaching from this application. The art cited by the Examiner does not teach or suggest the subject matter of the rejected claims.

In each instance of the art cited in the Final Action, the Examiner has dismissed the limitation that the steps of inputting and displaying a first target object and creating and displaying a corresponding dimension annotation and

creating a cross-association (steps (a) to (e) in new claim 7) are completed **prior to inputting another target object**, as being obviously "inherent in the prior art." As set out above, this conclusion is completely unsubstantiated – none of the cited references show this limitation. Absent a basis for the Examiner's position that the claimed timing limitation is taught or suggested in prior art, the Examiner's rejection of the claims cannot be sustained.

Accordingly, it is respectfully submitted that the Examiner has resorted to speculation, unfounded assumption or hindsight reconstruction of the art to supply deficiencies in the factual basis required to support a finding of obviousness. It is therefore believed that the Examiner's rejection of the claims is improper.

For the foregoing reasons, it is believed that the rejection of claims 8 to 18 as applied in the Final Action is in error. Reversal of the rejection is respectfully requested.

Respectfully submitted,

RICHARD R. HAWS et al.

Shawn D. Jacka
Registration No. 43,379

(8) Claims Appendix

7. (Cancelled)

8. (Currently Amended) A method for creating a computer aided design drawing formed of a plurality of target objects, comprising the steps of:

(a) inputting first coordinate position data;

(b) displaying a first target object corresponding to the first coordinate position data;

(c) creating first dimension annotation data correlated to the first coordinate position data;

(d) displaying a first dimension annotation correlated to the first dimension annotation data;

(e) cross-associating the first target object with the first dimension annotation, wherein as a result of such cross-association:

(i) a change in the first coordinate position data will effect a correlated change in the first dimension annotation data; and

(ii) a change in the first dimension annotation data will effect a correlated change in the first coordinate position data;

(f) subsequent to step (e), inputting further coordinate position data corresponding to at least one further target object;

(g) displaying the further target object in accordance with the further coordinate position data;

(h) creating further dimension annotation data correlated to the further coordinate position data;

(i) displaying a further dimension annotation correlated to the further dimension annotation data

(j) cross-associating the at least one further target object with the further dimension annotation, wherein as a result of such cross-association:

(i) a change in the further coordinate position data will effect a correlated change in the further dimension annotation data; and

(ii) a change in the further dimension annotation data will effect a correlated change in the further coordinate position data;

9. The method of claim 8, further comprising the steps of:

(k) determining if the at least one further target object intersects the first target object

(l) wherein if the at least one further target object intersects the first target object into a first segment and a second segment:

(i) calculating first segment coordinate position data;

(ii) calculating second segment coordinate position data;

(iii) creating first segment dimension annotation data correlated to the first segment coordinate position data;

(iv) displaying a first segment dimension annotation correlated to the first segment annotation data;

(v) creating second segment dimension annotation data correlated to the second segment coordinate position data;

(vi) displaying a second segment dimension annotation correlated to the second segment annotation data;

(vii) cross-associating the first segment with the first segment dimension annotation; and

(viii) cross-associating the second segment with the second segment dimension annotation.

10. The method of claim 8, further comprising the steps of:

(m) determining if the at least one further target object is adjacent to any other target object.

11. The method of claim 10, further comprising the steps of:

(n) inputting modifications to the further coordinate position data;

(o) displaying the further target object in accordance with the modified further coordinate position data;

(p) creating modified further dimension annotation data correlated to the modified further coordinate position data; and

(q) displaying a modified further dimension annotation correlated to the further dimension annotation data.

12. The method of claim 11, further comprising the steps of:

(r) if the at least one further target object is adjacent to the first target object:

(i) modifying the first coordinate position data in correlation to the modified further coordinate position data;

(ii) displaying the first target object in accordance with the modified first coordinate position data;

(iii) modifying the first dimension annotation data correlated to the modified first coordinate position data;

(iv) displaying a first dimension annotation correlated to the modified first dimension annotation data

13. A method for creating a computer aided design drawing formed of a plurality of target objects, comprising the steps of:

(a) inputting coordinate position data for a new target object;

(b) displaying the new target object corresponding to the coordinate position data;

(c) creating dimension annotation data correlated to the coordinate position data;

(d) displaying a dimension annotation correlated to the dimension annotation data;

(e) cross-associating the new target object with the dimension annotation, wherein in said cross-association:

(i) a change in the coordinate position data will effect a correlated change in the dimension annotation data; and

(ii) a change in the dimension annotation data will effect a correlated change in the coordinate position data;

(f) repeating steps (a) through (e) for at least one additional target object;

(g) wherein all of steps (a) through (e) are completed for one target object prior to inputting coordinate position data for any additional target object.

14. The method of claim 13, wherein step (a) further comprises the steps of:

(h) determining whether the new target object intersects any other target object; and

(i) wherein if the new target object intersects at least one other target object so as to create a first segment and a second segment:

(i) calculating first segment coordinate position data,

(ii) calculating second segment coordinate position data,

(iii) creating first segment dimension annotation data correlated to the first segment coordinate position data,

(iv) displaying a first segment dimension annotation correlated to the first segment annotation data,

(v) creating second segment dimension annotation data correlated to the second segment coordinate position data,

(vi) displaying a second segment dimension annotation correlated to the second segment annotation data,

(vii) cross-associating the first segment with the first segment dimension annotation, and

(viii) cross-associating the second segment with the second segment dimension annotation.

15. The method of claim 13, further comprising the step of:

(j) determining if the new target object is adjacent to any other target object.

16. The method of claim 15, further comprising the steps of:
    (k) selecting a target object;
    (l) inputting modified coordinate position data for the selected target object;
    (m) displaying the selected target object in accordance with the modified coordinate position data;
    (n) modifying the dimension annotation data corresponding to the selected target object, the modification correlated to the modified coordinate position data; and
    (o) displaying a modified dimension annotation correlated to the modified dimension annotation data.

17. The method of claim 16, further comprising the steps of:
    (p) if the selected target object is adjacent to at least one other adjacent target object:
        (i) adjusting the coordinate position data corresponding to the adjacent target object, wherein the adjustment is correlated to the modified coordinate position data;
        (ii) displaying the adjacent target object in accordance with the adjusted coordinate position data;
        (iii) adjusting the dimension annotation data corresponding to the adjacent target object, wherein the adjustment is correlated to the adjusted coordinate position data; and
        (iv) displaying a dimension annotation correlated to the adjusted dimension annotation data.

18. The method of claim 13, wherein step (a) further comprises the steps of:
    (q) determining whether the new target object superposes any other underlying target object; and

(r) wherein if the new target object superposes an underlying target object:

(i) creating at least one on-center dimension annotation data correlated to both the coordinate position data of the new target object and the coordinate position data of the underlying target object,

(ii) displaying an on-center dimension annotation correlated to the on-center annotation data,

(iii) cross-associating the new target object with the on-center dimension annotation, and

(iv) cross-associating the underlying target object with the on-center dimension annotation.

(9) Evidence Appendix

[BOREAN AND WALTON AFFIDAVITS ATTACHED]

NOTARIAL CERTIFICATE

I, **SHAWN DAVID JACKA**, lawyer and notary public in and for the Province of Ontario, Canada, certify that the document attached hereto is a true and exact photocopy of an original document entitled EVIDENTIARY DECLARATION OF DESMOND J. WALTON executed on the 10th day of May, 2004 by Desmond J. Walton.

Dated at Toronto, Ontario, this 3rd day of June, 2004.

SHAWN DAVID JACKA
Notary Public

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Richard R. Haws et al.
Serial No.: 09/589,758
Filed: 06/09/2000
For: AUTOMATIC ADAPTIVE DIMENSIONING FOR CAD SOFTWARE

Attorney Ref: 13999-1
Group: 2128
Examiner: FERRIS III, Fred O.

Honourable Commissioner of Patents
and Trademarks
Washington, DC 20231

EVIDENTIARY DECLARATION OF DESMOND J. WALTON

I, Desmond J. Walton, hereby say and declare:

1. I am a professor of computer science at the University of Manitoba, where I have been a member of the faculty since 1984.
2. I have an honours Bachelor of Science degree from the University of South Africa, which I obtained in 1967. I also obtained an M.S. in mathematics from the University of Illinois in 1971. My graduate credentials include a Masters of Science degree and a Ph.D., both in computer science from the University of Manitoba, which I received in 1974 and 1978, respectively.
3. I have worked in the private sector, including spending two years as a computer programmer/analyst for a civil engineering firm in Cape Town, South Africa, in addition to working for four years as a computer programmer/analyst with the Manitoba Department of Highways and Transportation.

4. My present research pursuits include the application of techniques from computer graphics, computer-aided geometric design and numerical analysis to problems in Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM). A sampling of my work is represented by the following selected publications:

   2003, D.J. Walton and D.S. Meek, Planar G^2 transition curves composed of cubic Bézier spiral segments, *Journal of Computational and Applied Mathematics*, **157**, 453-476.

   2003, Madi, Mohsen and Walton, Desmond, An interactive modification data structure for 3D surfaces, *International Journal of Machine Graphics & Vision*, **12**,(3), 293 – 310.

   1999, D.J. Walton and D.S. Meek, Planar G^2 transition between two circles with a fair cubic Bézier curve, *Computer-Aided Design* , **31**, 857-866.

   1998, D.J. Walton and D.S. Meek, Planar G^2 curve design with spiral segments, *Computer-Aided Design* **30**(7), 529-538.

5. Since 1990, I have performed collaborative work on several different projects with Institutes of the National Research Council (NRC), at first with the former Canadian Institute of Industrial Technology (CIIT), and presently with the Integrated Manufacturing Technologies Institute. NRC is a federal organization committed to research and technology transfer to benefit Canadian industries. Particular projects on which I collaborated are:

   1997/99 Smooth surface fitting for rapid prototyping.

   1990/92 Spline techniques for surfaces in CAD/CAM.

   1990/91 Estimation of wear in cylindrical mechanical parts using parametric periodic splines.

6. Additionally, in 1990/91 I spent a sabattical year of research leave with the CIIT, a former NRC institute. It was at this time that my collaborative work

with NRC was initiated by the latter two projects mentioned in the previous paragraph. During this year I was also involved with other projects and consultation on an ad hoc basis, including:

- consultation service in my area of expertise to employees of CIIT
- consultation service in my area of expertise to The Vision Engineering Research Group of Standard Aero, one of CIIT's partners.

7. As a result of my academic and work experience, I have developed particular expertise in computer graphics programming.
8. I currently teach computer science courses at the University of Manitoba, ranging from first year introductory computer programming courses, to graduate level courses which involve such complex subject matter as analysing and displaying curves and surfaces in computer graphics and visualization. By visualization I mean the graphical representation of objects or scientific data on a computer screen using techniques ranging from elementary line drawing to more sophisticated methods involving ray tracing and other ways of hidden-surface removal.
9. In addition to my other activities, I review articles relating to the field of computer graphics and specifically related to CAD/CAM for publication in various international journals. These articles are typically submitted by professionals, either academic or in practice, who use or do research in CAD and computer graphics. I also serve on the editorial board of the Elsevier journal, *Computer-Aided Design* (ISSN: 0010-4485). *Computer-Aided Design* is an established international journal that provides engineers, designers and computer scientists in academia and industry with key papers on research and developments in the application of computers to the design process.
10. I have reviewed, understood and am familiar with U.S. Patent Application No. 09/589,758 which is directed to technology for automatically generating each dimension annotation while creating a CAD drawing, and associating each such annotation with the corresponding target object, as

the target object is created. A copy of the patent application is attached as Schedule A to this Affidavit.

11. In the process of my review of the patent application, I have also reviewed each of claims 1 through 6 on pages 10 through 12 (the "Original Claims"), which I understand were the claims as originally filed.

12. I have also read the claims as amended (the "Amended Claims"). A copy of the Amended Claims is attached as Schedule B.

13. I also understand that the application was originally filed on June 9, 2000.

14. In my view, as of June 9, 2000, the description of the technology in the patent application is and was sufficiently full and complete, clear and concise to enable the programming and use of software capable of performing the methods as claimed in both the Original Claims and the Amended Claims. While programming typically requires routine debugging, no undue or unreasonable experimentation would be needed to reproduce the technology described in the application.

15. It should be understood that it is not typically required to provide excessively detailed information about a software program, in order for another programmer to reproduce it. In many cases, providing the functionality, or the way the software performs, is sufficient. The present patent application clearly describes the features and functions of the software as defined in the Original and Amended Claims, sufficiently for another programmer to reproduce and use it.

16. I am also of the view that the technology described in the application and claimed in the Original Claims and the Amended Claims was neither known nor obvious in view of generally available information as of the June 9, 2000 filing date. I was certainly not aware of such technology in June of 2000.

17. Based on my experience as a professor, I am well aware of the skills and abilities of computer science students within our department. I am specifically of the view that as of June 9, 2000, computer science students at the University of Manitoba during or at the completion of the third year

of their Bachelor's degree (typically a four year program), upon reading the patent application would be able to program and use the software as claimed in the Original and Amended Claims, without needing to obtain additional information from the inventors and without unreasonable experimentation.

18. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

SWORN BEFORE ME at the)
City of Winnipeg , in)
the Province of Manitoba)
this 10th day of May, 2004)
)
Larry Chivers)
A Notary Public in and for the Province of Manitoba

Desmond J. Walton
DESMOND J. WALTON

SCHEDULE "A"

AUTOMATIC ADAPTIVE DIMENSIONING FOR CAD SOFTWARE

Field of the Invention

This invention relates to computer software. In particular, this invention relates to an improvement in computer aided design (CAD) software.

Background of the Invention

There are many types of computer aided design (CAD) software which assist in architectural design and drafting. Such software is widely used, as it considerably simplifies the task of drafting plans to scale with such annotations as are required for the needs of the user.

One of the advantages of CAD software is a feature whereby an object can have dimension annotations associated with the object, including dimension lines, extension lines, symbols of termination (e.g. arrowheads, architectural ticks) and dimension text, created automatically. Thus, the dimension can be automatically created for an object as the object is drawn. This considerably simplifies the annotation of the drawing, which had previously had been a very time consuming process.

Some CAD programs allow manual associative dimensioning, by which a dimension annotation can be manually associated with an object, and thereafter if the object is moved the dimension annotation adjusts automatically with the object. This also facilitates the annotation of drawings, however it requires that the user manually attach the dimension to the object in order for changes in the object to be reflected in the associated dimension annotation. Furthermore, if the object is broken, for example if another object is interposed in or superposed onto an intermediate point of the existing object, the associative dimensioning cannot accommodate the new object and new dimensions, so new dimension annotations corresponding to the new object must be manually added and new associations must be established between the existing dimension annotation and the remaining portions of the existing object. This is a time consuming process, particularly during the modification stages of CAD drafting.

For example, adding a window to an existing wall in a CAD drawing requires that the window be inserted at the intended position, that the existing dimension annotations be deleted and that new extension lines, dimension lines, termination symbols and dimension text be created to reflect the new segmentation of the object and/or the addition of any new object (or the removal of an existing object).

It would accordingly be advantageous if dimension annotations were created automatically as objects are created, and automatically associated with the objects as they are created. It would further be advantageous if dimension annotations would change automatically to accommodate any change to the existing objects, such as a new object inserted into a selected position relative to the existing objects or the deletion of an object from a group of objects.

Summary of the Invention

The present invention overcomes these disadvantages by providing automatic adaptive dimensioning in a CAD software program. According to the invention, dimension annotations are created by the CAD program automatically as an object is drawn and automatically associated with the target object. Thereafter, changing the length of the target object automatically changes the associated dimension annotation, or alternatively, changing the associated dimension annotation automatically changes the length of the target object. Further, changing the dimension annotation associated with an adjacent object automatically changes the position of the target object.

Moreover, when another object is inserted into an intermediate position of an existing object, the automatic adaptive dimensioning feature of the invention automatically creates dimension annotations corresponding to the position of the new object relative to the existing object; likewise, the new object can be automatically positioned in relation to the existing object by specifying interposition dimensions or segment lengths in the existing dimension annotations. Thereafter, any changes to the lengths or relative positions of the objects will automatically change the associated dimension annotations, and any changes made to the associated dimension annotations will automatically change the lengths and/or relative positions of the objects.

Incorporating the automatic adaptive dimensioning feature of the invention into a CAD program accordingly substantially decreases the production time of architectural drawings. The commensurate savings in labour, particularly in the input, documentation and modification stages of drawing preparation, provides a considerable advantage over conventional CAD drawing programs.

These and other features of the invention will be apparent from the detailed description which follows.

The present invention thus provides a method of annotating a computer aided design drawing, comprising the steps of a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, b. creating a target object by selecting a length of the target object; and c. automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

The present invention further provides a computer program product for use with a computer, the computer program product comprising a computer usable medium having computer readable program code means embodied in said medium for annotating a computer aided design drawing, said computer program product having computer readable program code means for setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, computer readable program code means for creating a target object by selecting a length of the target object; and computer readable program code means for automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension

annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

The present invention further provides a program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for annotating a computer aided design drawing, said method steps comprising: a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, b. creating a target object by selecting a length of the target object; and c. automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

A further aspect of the invention includes the step of, in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

Brief Description of the Drawings

In drawings which illustrate by way of example only a preferred embodiment of the invention,

Figure 1 is a diagrammatic illustration of objects and associated dimension annotations in a conventional CAD drawing,

Figure 2 is a diagrammatic illustration of an object and associated dimension annotations in a CAD drawing using the method of the invention,

Figure 3 is a diagrammatic illustration of the drawing of Figure 2 after inserting a new object,

Figure 4 is a diagrammatic illustration of the drawing of Figure 3 after inserting a new object,

Figure 5 is a diagrammatic illustration of the drawing of Figure 4 after inserting a new object,

Figure 6 is a diagrammatic illustration of the drawing of Figure 5 after inserting a new object,

Figure 7 is a diagrammatic illustration of the drawing of Figure 6 after inserting a new object,

Figure 8 is a diagrammatic illustration of the drawing of Figure 7 after inserting a new object,

Figure 9 is a diagrammatic illustration of the drawing of Figure 8 after inserting a new object,

Figure 10 is a diagrammatic illustration of the drawing of Figure 9 after moving an existing object, and

Figure 11 is a diagrammatic illustration of the drawing of Figure 10 after deleting an object.

Detailed Description of the Invention

Figure 1 illustrates an architectural drawing by way of example. In a conventional CAD drawing program, line objects representing walls 10 and a windows 12 which are drawn or inserted in the CAD environment. Dimension text 20 specifying the lengths and relative positions of the objects 10, 12 are entered by the user, and in some CAD programs may be thereafter manually associated with each respective object 10, 12, so that a change in the length of the object is automatically reflected in the associated dimension text 20. Extension lines 22 are positioned or picked (selected) by the user for the desired dimension text, and dimension lines 24

and termination symbols 26 such as architectural ticks are either manually created by the user, or generated based on user-defined settings, based on the selected positions of the extension lines 22.

According to the invention, the dimension annotations are automatically created and associated with the respective objects to which they relate, and thereafter these dimension annotations are adaptive. Thus, the interposition or superposition of a new object in or onto an existing object automatically results in new extension lines 22 at the extremities of the new object, parsing of the existing dimension line 24 into segments with selected termination symbols 26, and the repositioning and recalculation of dimension text to accommodate the new object.

In use, to create a horizontal or vertical dimension associated with an object 10, 12, the object dimension text 20 can be selected by clicking, picking or otherwise specifying first and second points representing the ends of the object 10 or 12. In the case of multiple dimension strings, the locations of the dimension lines 24 (for example baseline strings or aligned strings) are also specified by the initial user settings, as are extension lines 22 and dimension text 20, with the selected termination symbols 26, which are thereafter generated automatically by the adaptive dimensioning feature of the invention based on the coordinate positions selected for the object. This feature of the invention also automatically trims or extends the dimensions annotations in response to a change in the size or position of the associated target object.

Thereafter, modifications to the existing objects 10, 12, may be made in two ways:

1. By modifying the length of the target object 8 itself and/or moving the target object to a new position relative to other objects. In this situation the associated dimension annotations automatically change to adapt to the modification of the associated object's dimension and/or position, moving extension lines, arrowheads or other termination symbols, and dimension text as necessary to accommodate the modification.

2. By changing dimension text to specify a new length for the target object 8, and/or changing the dimension text of an adjacent object to reposition the target object. In this case, the length of the object whose associated dimension text has been modified changes to correspond to the modified dimension. If the length of an adjacent object is changed, the target object is repositioned to remain adjacent to the adjacent object.

Specifics of the extension lines 22, alignment of dimension lines 24 (e.g. as aligned or baseline), type of termination symbols (e.g. architectural ticks), size and placement of dimension text 20, and any other desired parameters, are selected as setup parameters by the user before commencing drawing. The CAD drawing will automatically adaptively associate dimension annotations having the predefined parameters with the respective objects as they are inserted, deleted or modified.

Thus, in the example shown as a series of drawing steps in Figures 2 to 11, a target object 8, in Figure 2 being a wall 10a, is inserted into a new CAD drawing by selecting points 11a and 11b. Dimension annotations are automatically created by the method and computer program of the invention, by creating extension lines 22a aligned with the extremities of the target object 10a, creating a dimension line 24a with termination symbols 26a at its ends and creating dimension text 20a adjacent to the dimension line 24a (or as otherwise specified by the user in the setup parameters).

In Figure 3 the target object 8 is a new exterior wall 10b, added to the drawing of Figure 2 by selecting point 11c. Again dimension annotations are automatically created for the target object by aligning extension lines 22b with the extremities of the target object 8, creating a dimension line 24b with termination symbols 26b at its ends and creating dimension text 20b adjacent to the dimension line 24b. When a new target object 8 is created, for example another exterior wall 10c, by selecting point 11d, as shown in Figure 4, in addition to automatically creating dimension annotations for the new exterior wall 10c, the position of the dimension annotations for the previous object are automatically shifted to accommodate the new target object 8.

Figures 5, 6 and 7 each add a further target object 8, in each case an exterior wall 10d, 10e and 10f, by the selection of points 11e, 11f and 11a, respectively, to delimit the exterior of the structure, and in each case dimension annotations are automatically created for each target object 8 as the target object 8 is inserted, by creating extension lines 22d, 22e, 22f aligned with the extremities of the walls 10d, 10e and 10f, creating dimension lines 24d, 24e, 24f with termination symbols 26d, 26e, 26f at their respective ends and creating dimension text 20d, 20e, 20f adjacent to the respective dimension lines 24d, 24e, 24f.

In Figure 8 a target object 8 comprising a partition wall 10g is added to the drawing of Figure 7 by selecting points 11h and 11j. In this case the adaptive feature of the invention automatically creates extension lines 22g at the appropriate points on the existing dimension lines 24a, 24f, parses the existing dimension lines 24a, 24f into segments 24g, and deletes the existing dimension text 20a, 20f and replaces it with new dimension text 20g relating to the newly created dimension line segments 24g. Similarly, when a target object 8 comprising a window 12 is added in Figure 9, the adaptive dimensioning feature of the invention automatically creates a new dimension line 24h (as specified by the user in the setup parameters) at the window 12 having an on-center extension line 22h with associated dimension text 20h and termination symbols 26h.

In Figure 10, the target object 8 is wall 10c adjacent to the wall 10d with the window 12. Wall 10c is repositioned by dragging the wall 10c to a new position from the previous position (shown in phantom lines). The automatic adaptive dimensioning feature of the invention automatically moves all associated extension lines 22b, 22d to align with the repositioned wall 10c, and replaces the existing dimension text 20b, 22d of the resized walls 10b, 10d with new dimension text 20b, 20d reflecting the new position of the wall 10c relative to adjacent objects. The lengths of walls 10b, 10d adjacent to the target object 8 (wall 10c) automatically adjust to the new position of wall 10c.

To complete the drawing, in Figure 11 the partition wall 10g (shown in phantom lines) has been deleted. The automatic adaptive dimensioning feature of the

invention deletes the extension lines 22 previously associated with the partition 10g to reconstitute the original dimension lines 24f, deletes the dimension text 20g of the parsed dimension line segments 24g, and restores the original dimension text 24f (from Figure 7).

Thus, the invention provides an automatic adaptive dimensioning feature in a CAD program which automatically creates and associates dimension annotations as an object is inserted into a drawing, and modifies the dimension annotations as an object is added, deleted or modified in the drawing. The invention thus provides a method of creating and modifying a CAD drawing which considerably simplifies the CAD documentation process.

The automatic adaptive dimensioning feature of the invention can be programmed into CAD software, or can be created as an independent program loaded as a "plug-in" for existing CAD software.

A preferred embodiment of the present invention having been thus described by way of example, variations and modifications will be apparent to those skilled in the art. The invention includes all such variations and modifications as fall within the scope of the appended claims.

I CLAIM:

1. A method of annotating a computer aided design drawing, comprising the steps of

a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols,

b. creating a target object by selecting a length of the target object; and

c. automatically generating dimension annotations corresponding to the target object,

whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

2. The method of claim 1 further including the step:

d. in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

3. A computer program product for use with a computer, the computer program product comprising a computer usable medium having computer readable program code means embodied in said medium for annotating a computer aided design drawing, said computer program product having

computer readable program code means for setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols,

computer readable program code means for creating a target object by selecting a length of the target object; and

computer readable program code means for automatically generating dimension annotations corresponding to the target object,

whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

4. The computer program product of claim 3, further comprising computer readable program code means for in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

5. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for annotating a computer aided design drawing, said method steps comprising:

a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols,

b. creating a target object by a length of the target object; and

c. automatically generating dimension annotations corresponding to the target object,

whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension

annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

6. The program storage device of claim 5, further including a method step comprising:

d. in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

Abstract

An automatic adaptive dimensioning program for CAD software in which dimension annotations are created by the CAD program automatically as an object is drawn and automatically associated with the object. Thereafter, changing the length of the object automatically changes the associated dimension annotation, or alternatively, changing the associated dimension annotation automatically changes the length of the object. When another object is interposed into or superposed onto an intermediate position of the existing object, the automatic adaptive dimensioning annotation feature of the invention automatically creates dimension annotations corresponding to the position of the new object relative to the existing object. The new object can be automatically positioned in relation to the existing object by specifying interposition dimensions or segment lengths in the dimension annotations.

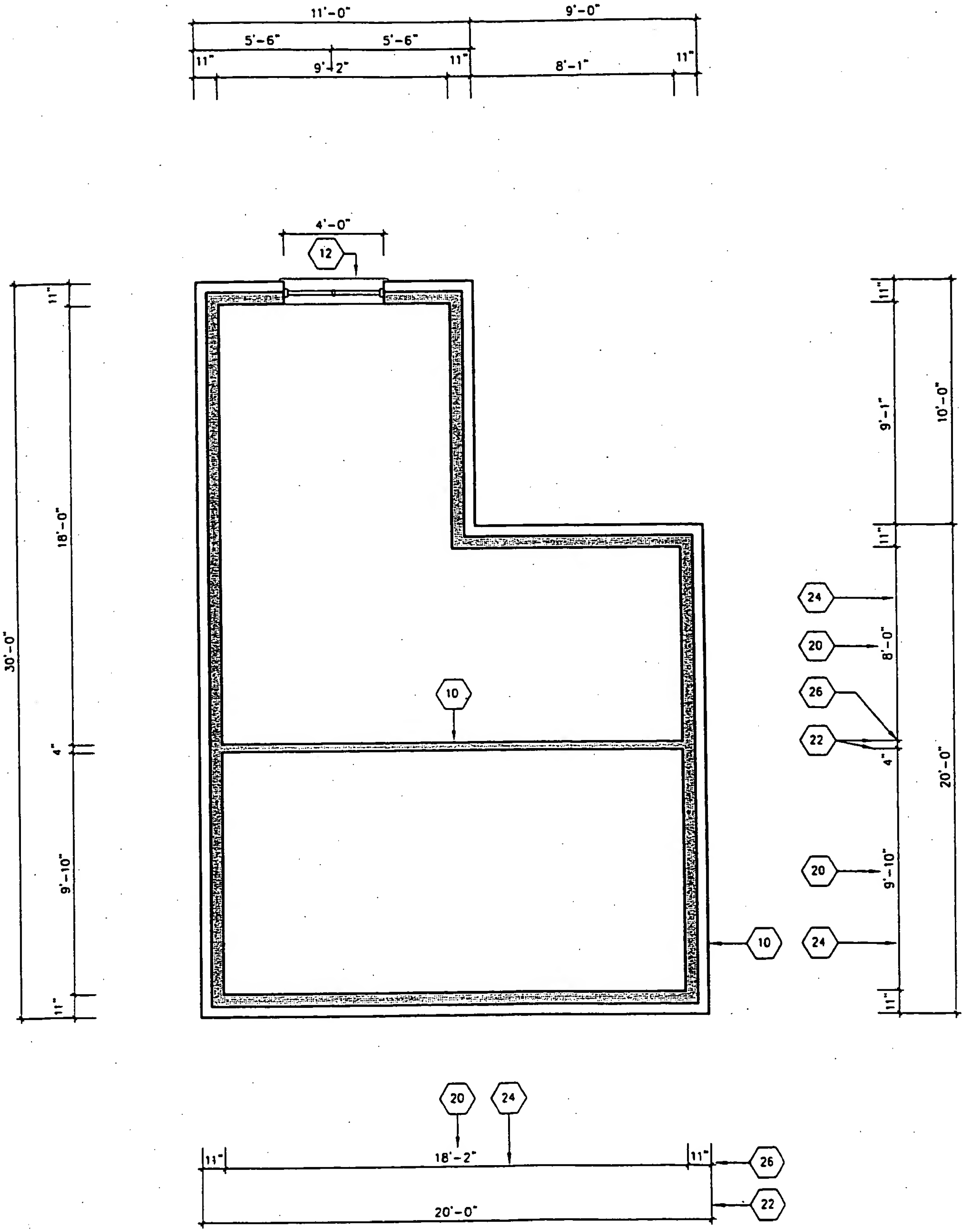

11'-0"
9'-0"
5'-6"
5'-6"
11"
9'-2"
11"
8'-1"
11"
4'-0"
12
11"
18'-0"
30'-0"
4"
9'-10"
11"
11"
9'-1"
10'-0"
11"
24
20
8'-0"
26
22
4"
20'-0"
10
20
9'-10"
10
24
11"
20
24
11"
18'-2"
11"
26
20'-0"
22

figure 1

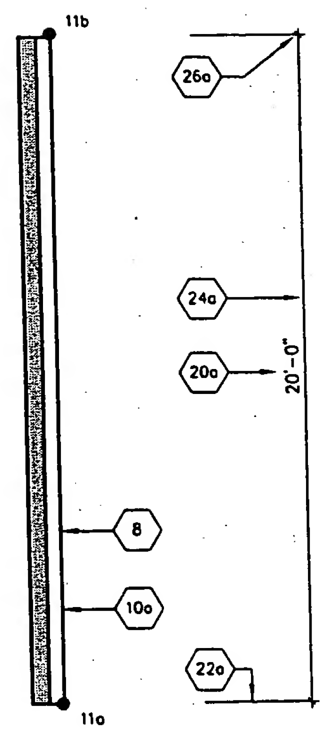
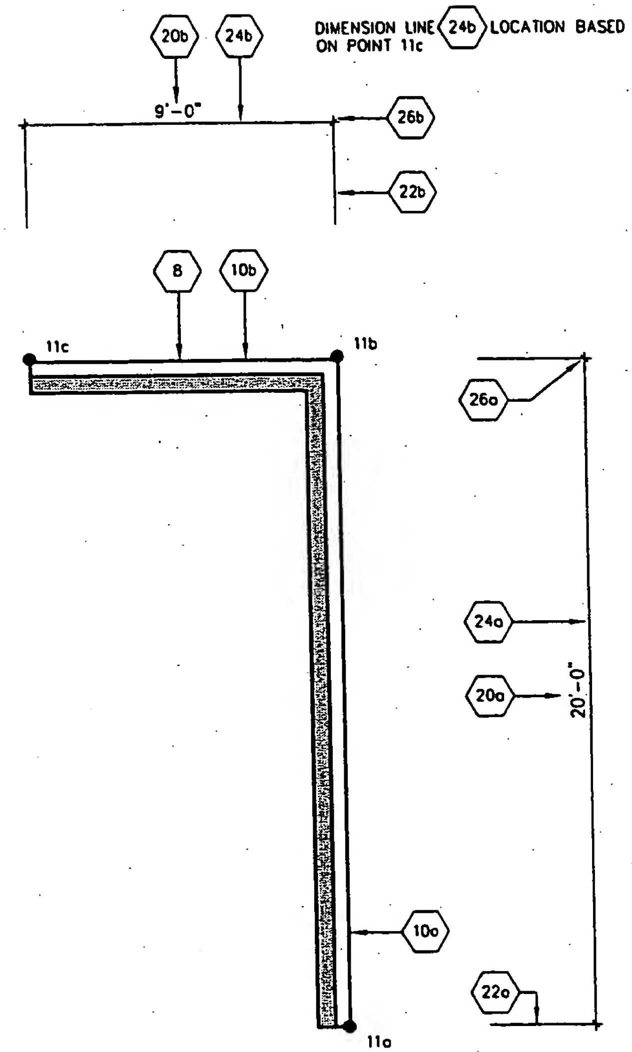


figure 2



20b
24b
DIMENSION LINE 24b LOCATION BASED ON POINT 11c
9'-0"
26b
22b
8
10b
11c
11b
26a
24a
20a
20'-0"
10a
22a
11a

figure 3

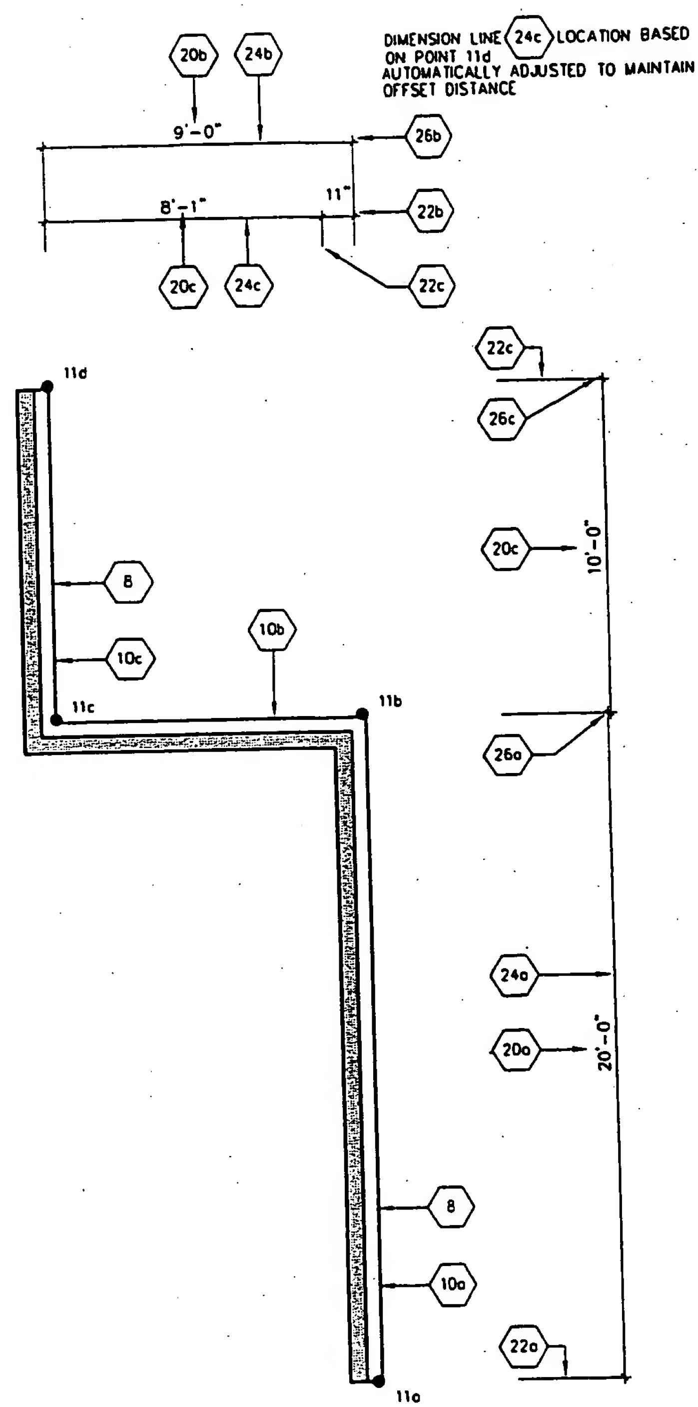

DIMENSION LINE 24c LOCATION BASED ON POINT 11d AUTOMATICALLY ADJUSTED TO MAINTAIN OFFSET DISTANCE
20b
24b
9'-0"
26b
8'-1"
11"
22b
20c
24c
22c
11d
22c
26c
20c
10'-0"
8
10c
10b
11c
11b
26a
24a
20a
20'-0"
8
10a
22a
11a

figure 4

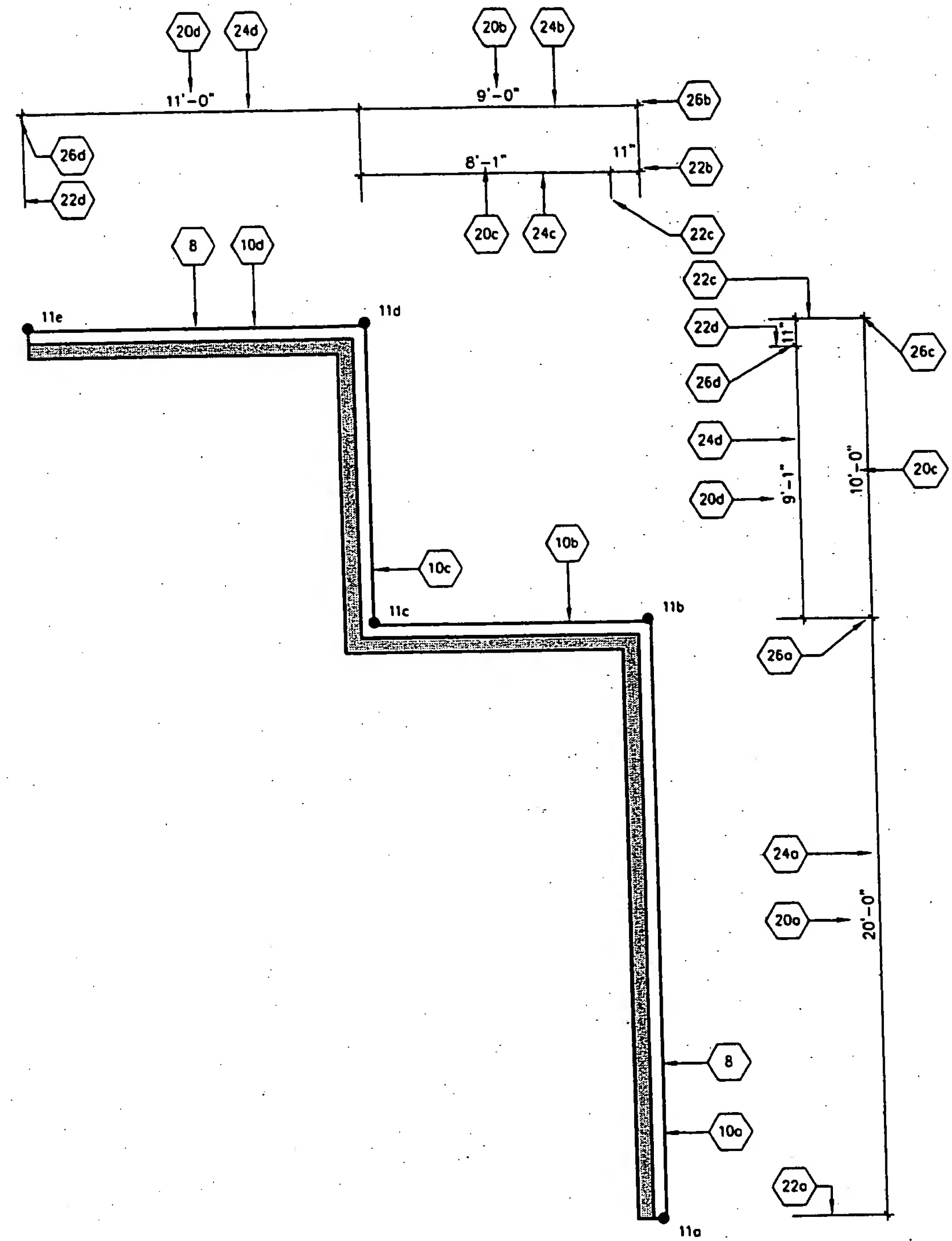
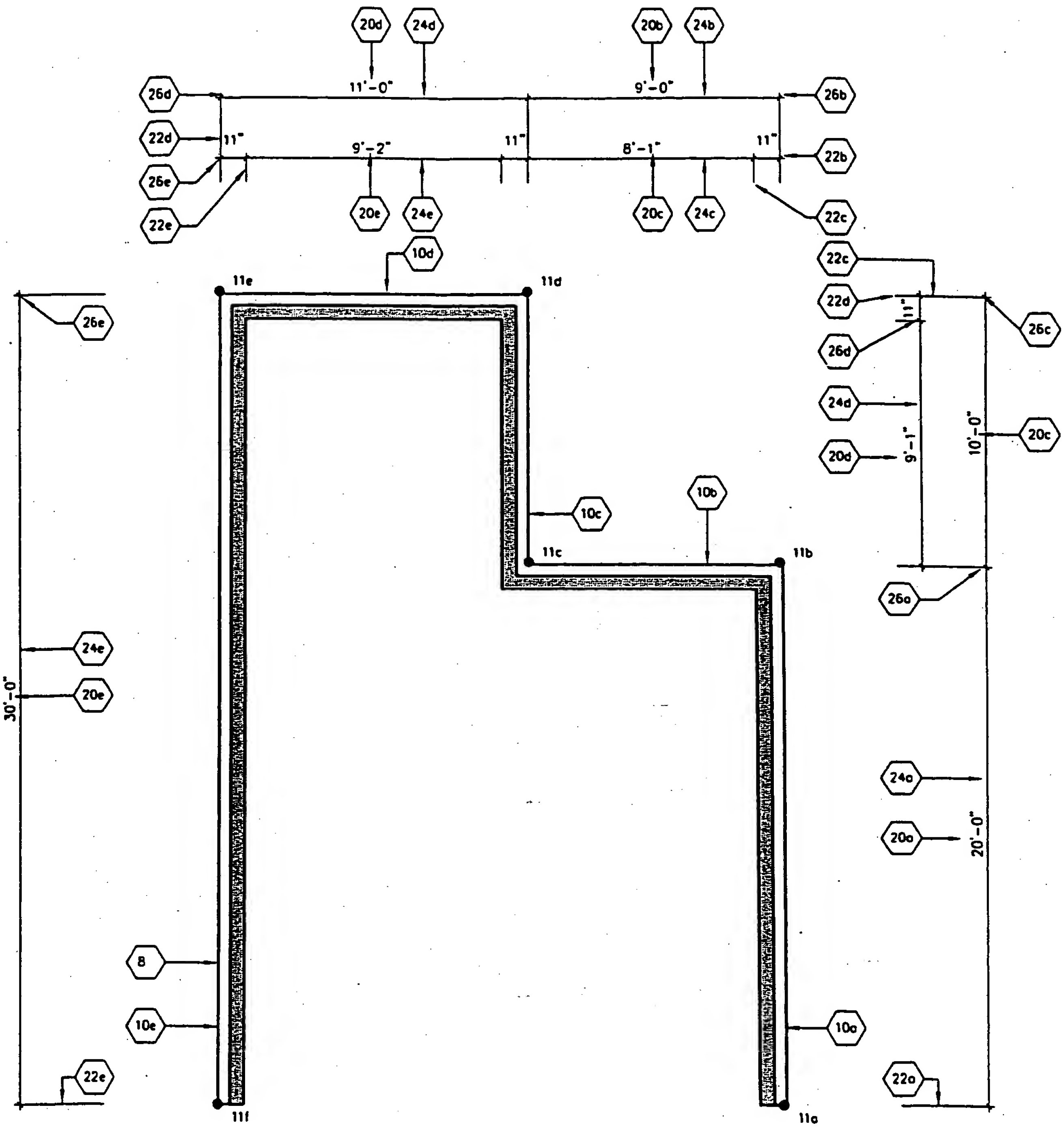

20d
24d
20b
24b
11'-0"
9'-0"
26b
26d
8'-1"
11"
22b
22d
20c
24c
22c
8
10d
22c
11e
11d
22d
11"
26c
26d
24d
10'-0"
20c
20d
9'-1"
10b
10c
11c
11b
26a
24a
20a
20'-0"
8
10a
22a
11a

figure 5



20d
24d
20b
24b
26d
11'-0"
9'-0"
26b
22d
11"
9'-2"
11"
8'-1"
11"
22b
26e
22e
20e
24e
20c
24c
22c
10d
11e
11d
22c
22d
11"
26c
26e
26d
24d
9'-1"
10'-0"
20c
20d
10c
10b
11c
11b
26a
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20e
24a
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20'-0"
8
10e
10a
22e
22a
11f
11a

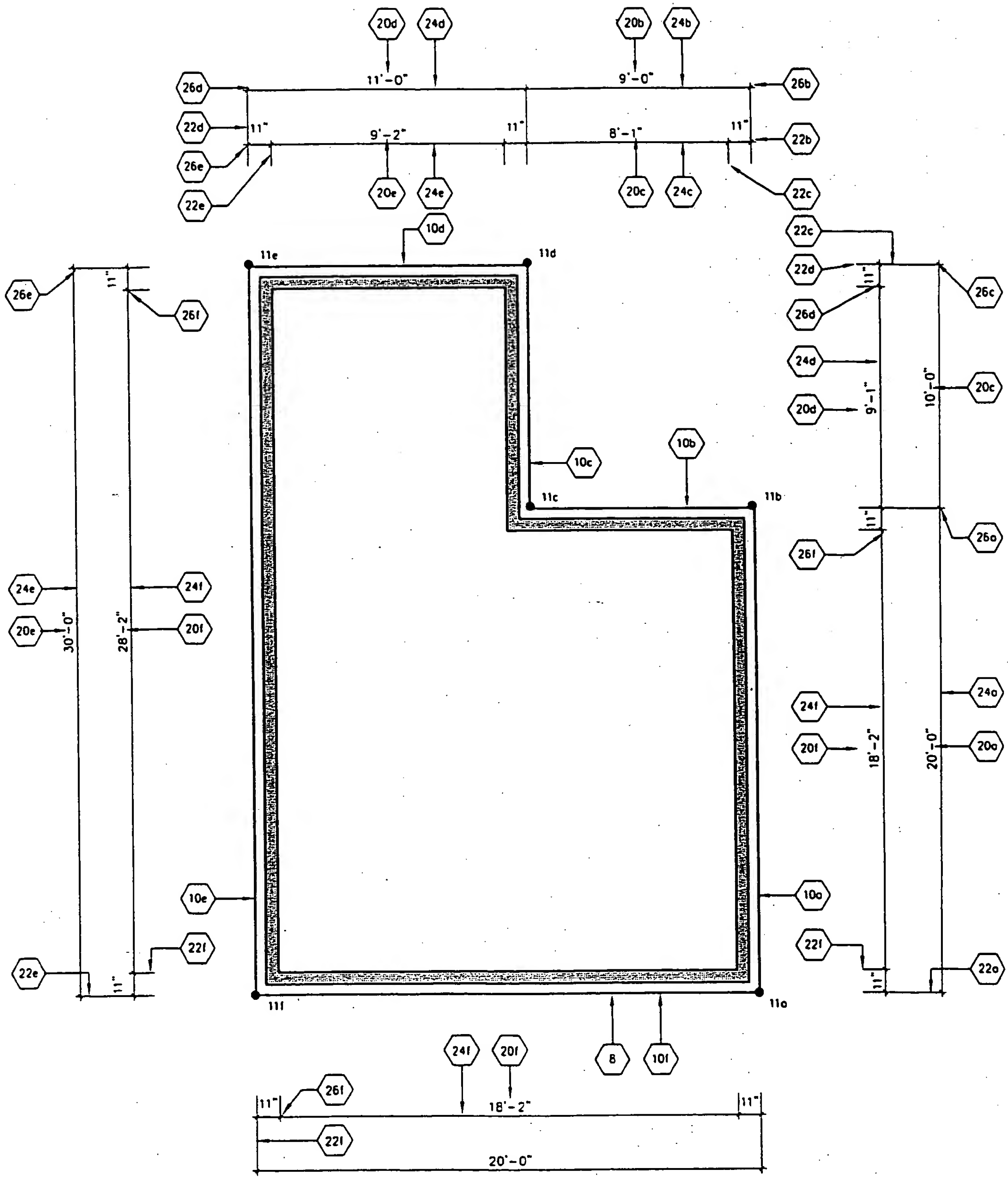

20d
24d
20b
24b
26d
11'-0"
9'-0"
26b
22d
11"
9'-2"
11"
8'-1"
11"
22b
26e
22e
20e
24e
20c
24c
22c
10d
22c
11e
11d
22d
26e
26f
26d
26c
24d
20d
9'-1"
10'-0"
20c
10c
10b
11c
11b
26f
26a
24e
24f
20e
20f
30'-0"
28'-2"
24f
24a
20f
20a
18'-2"
20'-0"
10e
10a
22e
22f
22f
22a
11"
11f
11a
24f
20f
8
10f
26f
18'-2"
22f
20'-0"

figure 7

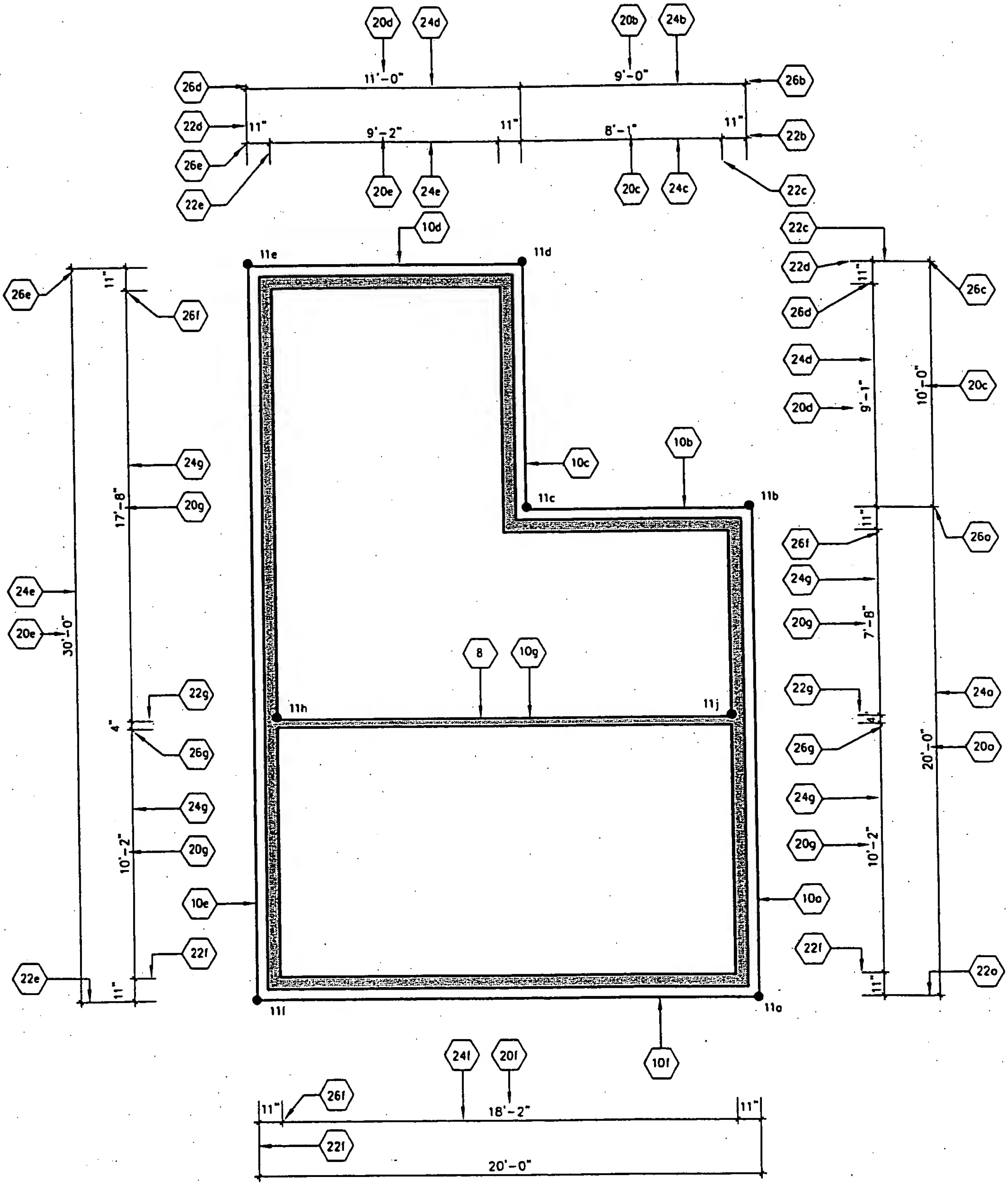


figure 8

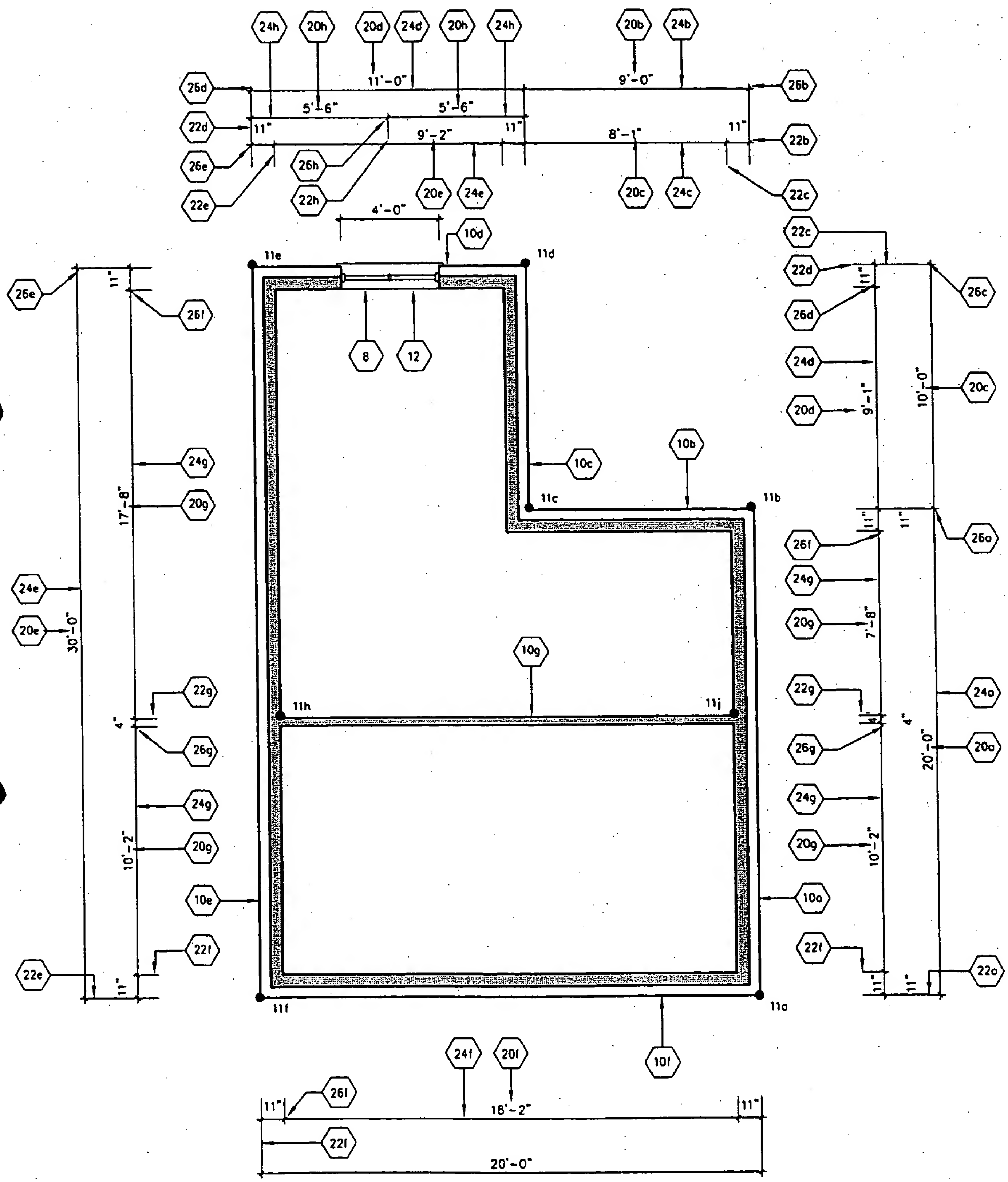
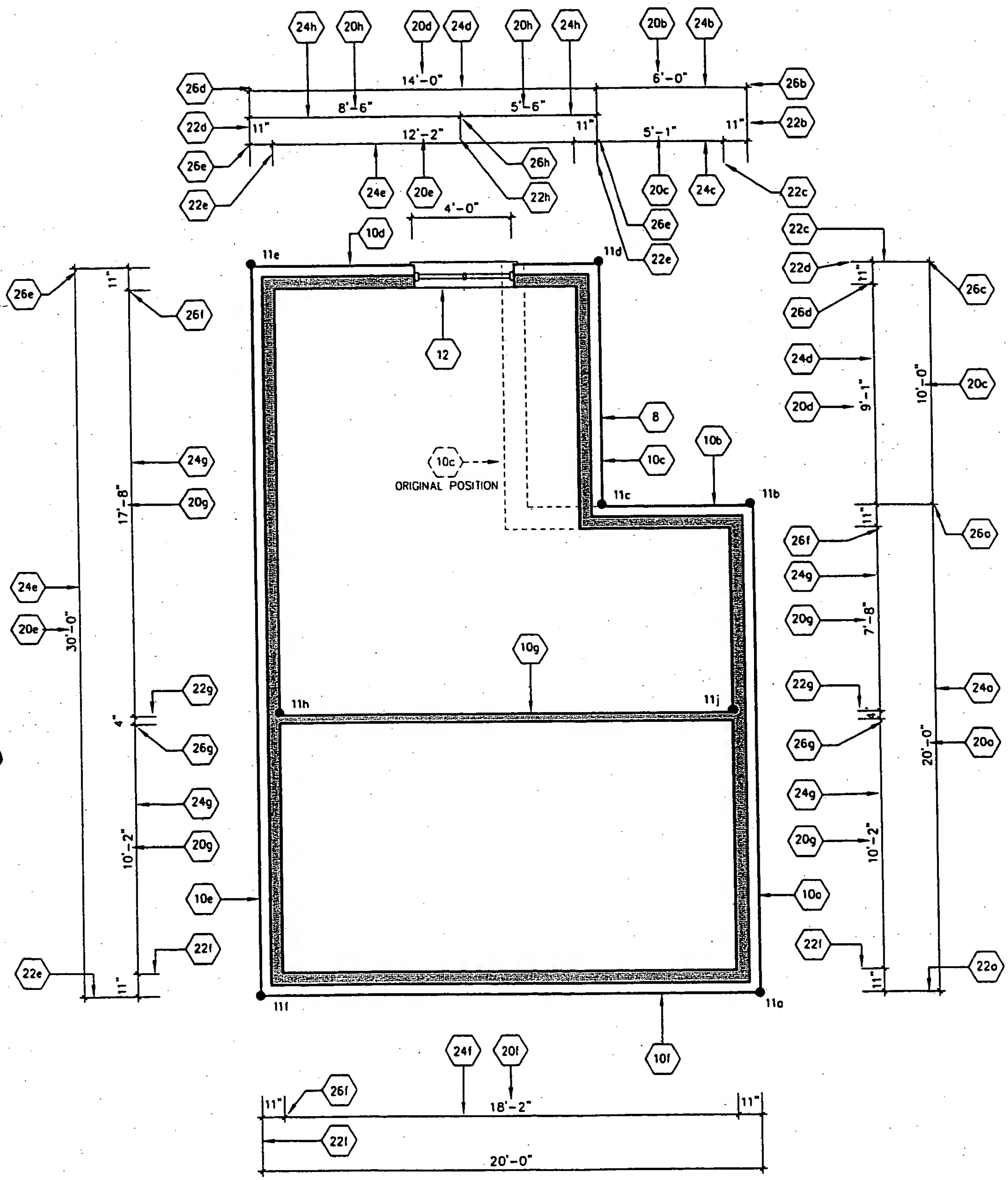
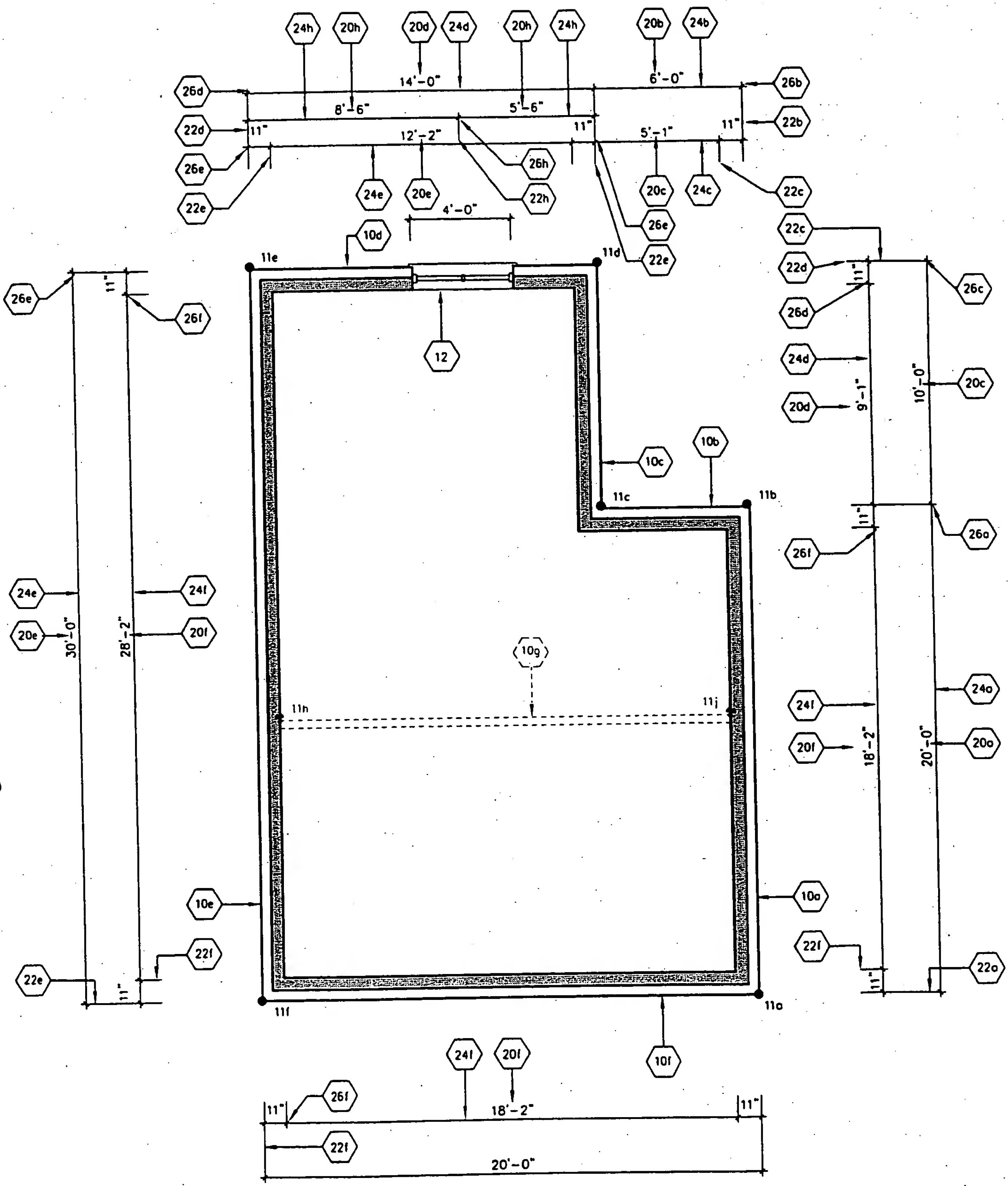


figure 9



24h
20h
20d
24d
20h
24h
20b
24b
26d
14'-0"
6'-0"
26b
8'-6"
5'-6"
22d
11"
12'-2"
11"
5'-1"
11"
22b
26e
26h
22e
24e
20e
22h
20c
24c
22c
4'-0"
26e
10d
22c
11e
11d
22e
22d
26c
26e
11"
26f
26d
12
24d
10'-0"
20c
20d
9'-1"
8
24g
10c
10b
10c
ORIGINAL POSITION
17'-8"
20g
11c
11b
11"
26o
26f
24e
24g
30'-0"
20e
7'-8"
20g
10g
22g
22g
11h
11j
4"
26g
24o
4"
26g
20'-0"
20o
24g
24g
20g
10'-2"
20g
10'-2"
10e
10o
22f
22f
22e
11"
22o
11"
11f
11o
24f
20f
10f
26f
11"
18'-2"
11"
22f
20'-0"


24h
20h
20d
24d
20h
24h
20b
24b
26d
14'-0"
6'-0"
26b
8'-6"
5'-6"
22d
11"
11"
5'-1"
11"
22b
12'-2"
26h
26e
22e
24e
20e
22h
20c
24c
22c
4'-0"
26e
22c
10d
11e
11d
22e
22d
26c
26e
11"
26f
26d
12
24d
10'-0"
20c
20d
9'-1"
10b
10c
11c
11b
11"
26a
26f
24e
24f
20e
30'-0"
28'-2"
20f
10g
11h
11j
24f
24a
20f
18'-2"
20'-0"
20a
10e
10a
22f
22f
22a
22e
11"
11"
11f
11a
24f
20f
10f
26f
11"
18'-2"
11"
22f
20'-0"
figure 11

SCHEDULE "B"

1. A method for creating a computer aided design drawing formed of a plurality of target objects, comprising the steps of:
   (a) inputting first coordinate position data;
   (b) displaying a first target object corresponding to the first coordinate position data;
   (c) creating first dimension annotation data correlated to the first coordinate position data;
   (d) displaying a first dimension annotation correlated to the first dimension annotation data; and
   (e) cross-associating the first target object with the first dimension annotation, wherein as a result of such cross-association:
      (i) a change in the first coordinate position data will effect a correlated change in the first dimension annotation data; and
      (ii) a change in the first dimension annotation data will effect a correlated change in the first coordinate position data.

2. The method of claim 1 further comprising the steps of:
   (f) subsequent to step (e), inputting further coordinate position data corresponding to at least one further target object;
   (g) displaying the further target object in accordance with the further coordinate position data;
   (h) creating further dimension annotation data correlated to the further coordinate position data;
   (i) displaying a further dimension annotation correlated to the further dimension annotation data
   (j) cross-associating the at least one further target object with the further dimension annotation, wherein as a result of such cross-association:

(i) a change in the further coordinate position data will effect a correlated change in the further dimension annotation data; and

(ii) a change in the further dimension annotation data will effect a correlated change in the further coordinate position data;

3. The method of claim 2, further comprising the step of:

(k) determining if the at least one further target object intersects the first target object

(l) wherein if the at least one further target object intersects the first target object into a first segment and a second segment:

(i) calculating first segment coordinate position data;

(ii) calculating second segment coordinate position data;

(iii) creating first segment dimension annotation data correlated to the first segment coordinate position data;

(iv) displaying a first segment dimension annotation correlated to the first segment annotation data;

(v) creating second segment dimension annotation data correlated to the second segment coordinate position data;

(vi) displaying a second segment dimension annotation correlated to the second segment annotation data;

(vii) cross-associating the first segment with the first segment dimension annotation; and

(viii) cross-associating the second segment with the second segment dimension annotation.

4. The method of claim 2, further comprising the step of:

(m) determining if the at least one further target object is adjacent to any other target object.

5. The method of claim 4, further comprising the step of:

(n) inputting modifications to the further coordinate position data;

(o) displaying the further target object in accordance with the modified further coordinate position data;

(p) creating modified further dimension annotation data correlated to the modified further coordinate position data; and

(q) displaying a modified further dimension annotation correlated to the further dimension annotation data.

6. The method of claim 5, further comprising the steps of:

(r) if the at least one further target object is adjacent to the first target object:

(i) modifying the first coordinate position data in correlation to the modified further coordinate position data;

(ii) displaying the first target object in accordance with the modified first coordinate position data;

(iii) modifying the first dimension annotation data correlated to the modified first coordinate position data;

(iv) displaying a first dimension annotation correlated to the modified first dimension annotation data

7. A method for creating a computer aided design drawing formed of a plurality of target objects, comprising the steps of:

(a) inputting coordinate position data for a new target object;

(b) displaying the new target object corresponding to the coordinate position data;

(c) creating dimension annotation data correlated to the coordinate position data;

(d) displaying a dimension annotation correlated to the dimension annotation data;

(e) cross-associating the new target object with the dimension annotation, wherein in said cross-association:

(i) a change in the coordinate position data will effect a correlated change in the dimension annotation data; and

(ii) a change in the dimension annotation data will effect a correlated change in the coordinate position data;

(f) repeating steps (a) through (e) for at least one additional target object;

(g) wherein all of steps (a) through (e) are completed for one target object prior to inputting coordinate position data for any additional target object.

8. The method of claim 7, wherein step (a) further comprises the steps of:

(a) determining whether the new target object intersects any other target object; and

(b) wherein if the new target object intersects at least one other target object so as to create a first segment and a second segment:

(i) calculating first segment coordinate position data,

(ii) calculating second segment coordinate position data,

(iii) creating first segment dimension annotation data correlated to the first segment coordinate position data,

(iv) displaying a first segment dimension annotation correlated to the first segment annotation data,

(v) creating second segment dimension annotation data correlated to the second segment coordinate position data,

(vi) displaying a second segment dimension annotation correlated to the second segment annotation data,

(vii) cross-associating the first segment with the first segment dimension annotation, and

(viii) cross-associating the second segment with the second segment dimension annotation.

9. The method of claim 7, further comprising the step of:

(a) determining if the new target object is adjacent to any other target object.

10. The method of claim 9, further comprising the step of:

(a) selecting a target object;

(b) inputting modified coordinate position data for the selected target object;

(c) displaying the selected target object in accordance with the modified coordinate position data;

(d) modifying the dimension annotation data corresponding to the selected target object, the modification correlated to the modified coordinate position data; and

(e) displaying a modified dimension annotation correlated to the modified dimension annotation data.

11. The method of claim 10, further comprising the step of:

(a) if the selected target object is adjacent to at least one other adjacent target object:

(i) adjusting the coordinate position data corresponding to the adjacent target object, wherein the adjustment is correlated to the modified coordinate position data;

(ii) displaying the adjacent target object in accordance with the adjusted coordinate position data;

(iii) adjusting the dimension annotation data corresponding to the adjacent target object, wherein the adjustment is correlated to the adjusted coordinate position data; and

(iv) displaying a dimension annotation correlated to the adjusted dimension annotation data.

12. The method of claim 7, wherein step (a) further comprises the steps of:

(a) determining whether the new target object superposes any other underlying target object; and

(b) wherein if the new target object superposes an underlying target object:

(i) creating at least one on-center dimension annotation data correlated to both the coordinate position data of the new target object and the coordinate position data of the underlying target object,

(ii) displaying an on-center dimension annotation correlated to the on-center annotation data,

(iii) cross-associating the new target object with the on-center dimension annotation, and

(iv) cross-associating the underlying target object with the on-center dimension annotation.

NOTARIAL CERTIFICATE

I, **SHAWN DAVID JACKA**, lawyer and notary public in and for the Province of Ontario, Canada, certify that the document attached hereto is a true and exact photocopy of an original document entitled EVIDENTIARY DECLARATION OF DAVID C. BOREAN executed on the 27th day of May, 2004 by David C. Borean.

Dated at Toronto, Ontario, this 3rd day of June, 2004.

SHAWN DAVID JACKA
Notary Public

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

Richard R. Haws et al. | **Attorney Ref: 13999-1**

Serial No.: 09/589,758 | **Group: 2128**

Filed: 06/09/2000 | **Examiner: FERRIS III, Fred O.**

For: AUTOMATIC ADAPTIVE DIMENSIONING FOR CAD SOFTWARE

Honourable Commissioner of Patents
and Trademarks
Washington, DC 20231

EVIDENTIARY DECLARATION OF DAVID C. BOREAN

I, David C. Borean, hereby say and declare:

1. I am a software application architect with the Ministry of Transportation of Ontario (MTO). I have been on contract with the MTO since 2003 working on converting applications from the obsolete OS/2 platform to the Windows XP platform.

2. I have a Bachelor of Mathematics degree from the University of Waterloo, which I obtained in 1996. Although my degree is technically in mathematics, my degree program included a number of general computer programming courses.

3. While obtaining my degree, I was enrolled in a co-op program which allowed students to alternate work semesters with in-class semesters, in order to develop work experience. Between 1992 and 1994, during my work semesters, I worked as a software developer for Thinkage Software

Ltd., a Canadian software company which developed low-level software tools. During my work semester in 1995, I worked as a systems analyst for Wilfred Laurier University.

4. After graduation, I was employed as a software developer for Castek Software Factory, a Canadian software development company specializing in component based software for the financial sector, between 1996 and 2000.

5. Between 2001 and 2003, I was a software programmer and application architect with DWL Inc., a software company which specializes in developing software for top tier insurance and banking firms in Canada and the United States.

6. In February of 2000, Rick Haws, one of the inventors of U.S. Patent Application No. 09/589,758, approached me for the purpose of obtaining my assistance in programming computer–aided design (CAD) software which would provide automatic adaptive dimensioning ("Automatic Adaptive Dimensioning"). Mr. Haws is a designer who had invented a method for improving the manner in which CAD drawings are provided with dimension annotations.

7. Mr. Haws indicated to me that the Automatic Adaptive Dimensioning was to create a dimension annotation for each object in a drawing (for example, a line representing a wall in an architectural drawing) as soon as the object is created. The Automatic Adaptive Dimensioning functionality was also to provide a cross-association between the object and the dimension annotation, so that a change in one would effect a corresponding change in the other.

8. Mr. Haws described the steps of the method to be carried out in implementing the Automatic Adaptive Dimensioning functionality. I was also shown a series of diagrams which illustrated the intended Automatic Adaptive Dimensioning functionality.

9. I estimated it would take me approximately one month (160 hours) to design and program the desired module for Mr. Haws.

10. By the middle of March of 2000, I had completed the final version of the software application entitled *RN Design Auto Dimension Program* (the "Software Application"), and forwarded it to Mr. Haws. I had developed the Software Application as a module to be used with the *AutoCAD* software generally available to designers, which module would provide Automatic Adaptive Dimensioning functionality. My work on the Software Application was routine and straightforward. Upon completion, the Software Application provided the desired Automatic Adaptive Dimensioning functionality. I was able to complete the programming within the estimate of 160 hours of development work.

11. Attached as Schedule A to this Affidavit is a copy of the manual which describes the Automatic Adaptive Dimensioning functionality of the Software Application.

12. I understand that Mr. Haws subsequently used the Software Application in his practise as a designer in preparing architectural drawings.

13. I have reviewed, understood and am familiar with U.S. Patent Application No. 09/589,758 which discloses Automatic Adaptive Dimensioning technology. A copy of the patent application is attached as Schedule B to this Affidavit.

14. In the process of my review of the patent application, I have also reviewed each of claims 1 through 6 on pages 10 through 12 (the "Original Claims"), which I understand were the claims as originally filed.

15. I have also read the claims as amended (the "Amended Claims"). A copy of the Amended Claims is attached as Schedule C.

16. I understand that the patent application was filed on June 9, 2000.

17. The patent application clearly describes the Automatic Adaptive Dimensioning method and technology, which is claimed in the Original and Amended Claims, and is consistent both in terms of scope and content with the information Mr. Haws provided to me in February of 2000. The Original and Amended Claims are fully supported by the patent application.

18. The information I received in February of 2000 was sufficiently full and complete, clear and concise to enable me to routinely and directly program the Software Application which successfully performed the methods as claimed in both the Original Claims and the Amended Claims. As I noted previously, the information I was provided in February of 2000 was substantially the same as that disclosed in the patent application and was in no way more sufficient, detailed or comprehensive than what is disclosed in the patent application.

19. In my view and having reviewed the patent application, I can state that as of June 9, 2000, the description of the technology in the patent application is and was sufficiently full and complete, clear and concise to enable me or any competent programmer to program and use software capable of performing the methods as claimed in both the Original Claims and the Amended Claims.

20. Any such competent programmer would be familiar with or could easily access and understand information describing the object model of AutoCAD or a similar CAD software program, and Visual Basic, a programming language in which customized modules for AutoCAD may be programmed. Such information about AutoCAD and Visual Basic was widely known and commonly available to competent programmers as of the filing date of the patent application.

21. From my experience in creating the Software Application, and based on my experience in numerous software projects over the course of my career, I can also state that my programming of the Software Application was straightforward and did not require any undue or unreasonable experimentation.

22. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

SWORN BEFORE ME at the)
City of Toronto, in)
the Province of Ontario)
this 27th day of May, 2004)
SHAWN DAVID JACKA)
_______________________)
A Notary Public in and for the
Province of Ontario

____
DAVID C. BOREAN

SCHEDULE "A"

Overview:

RN Design Auto Dimension Program v2.0.

In order to use this suite of tools effectively, we must adhere to certain strict guidelines. Contained within the following pages is a guide on the general usage of the Auto Dimensioning product as well as notes on how to use the program and not have it fail.

Table of Contents:

The **Launching**, **Dimensioning** and **Elevating programs** are the three major elements of the Auto Dimensioning suite of Programs.

Launching Program:

This was created to speed up the overall execution of AutoCAD. There are certain times when having the dimensioning program running will slow down the execution of commands to a point where work flow is disrupted.

Upon opening of AutoCAD, the bootstrapping program is loaded and the Dimensioning program is by default, **Disabled**.

On the Menu Bar, the status of the program is displayed as one of three options:

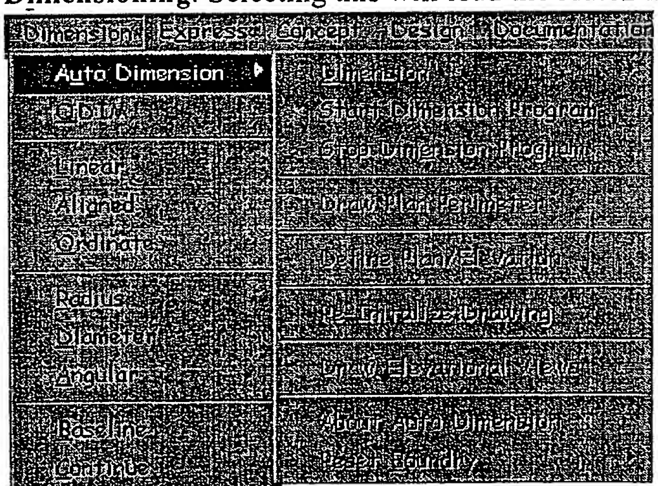
AutoDim DISABLED

AutoDim ENABLED

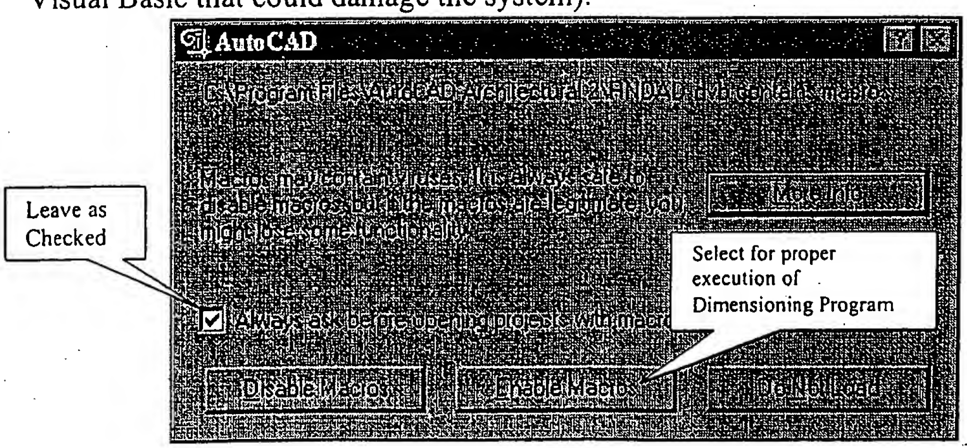
AutoDIM ENABLED INITIALIZED

Disabled means, that the program is not loaded and will not perform any dimensioning or elevating functions. (See header of 1st page for Menu example)

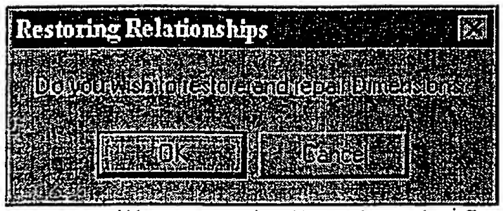
Under the **Dimension** menu item the only available function is to **Start Dimensioning**. Selecting this will load the AutoDim Program into memory.



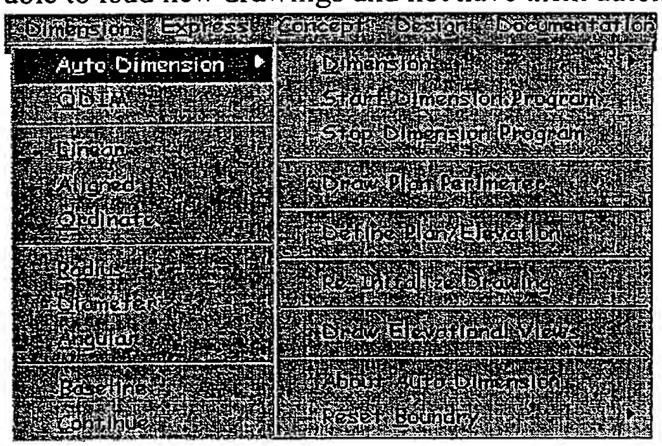
The program will ask you if you wish to enable Macros before proceeding with the load. Select Enable Macros, (you should **not** de-select the "Always ask before opening projects with macros" checkbox, as this protects against viruses written in Visual Basic that could damage the system).



AutoDim **Enabled** means that the program is in memory and certain functions are available. However most of the functions will not work if the program is merely enabled. When loaded and the drawing is **Re-Initialized**, you are prompted to Restore / Repair Dimensions.

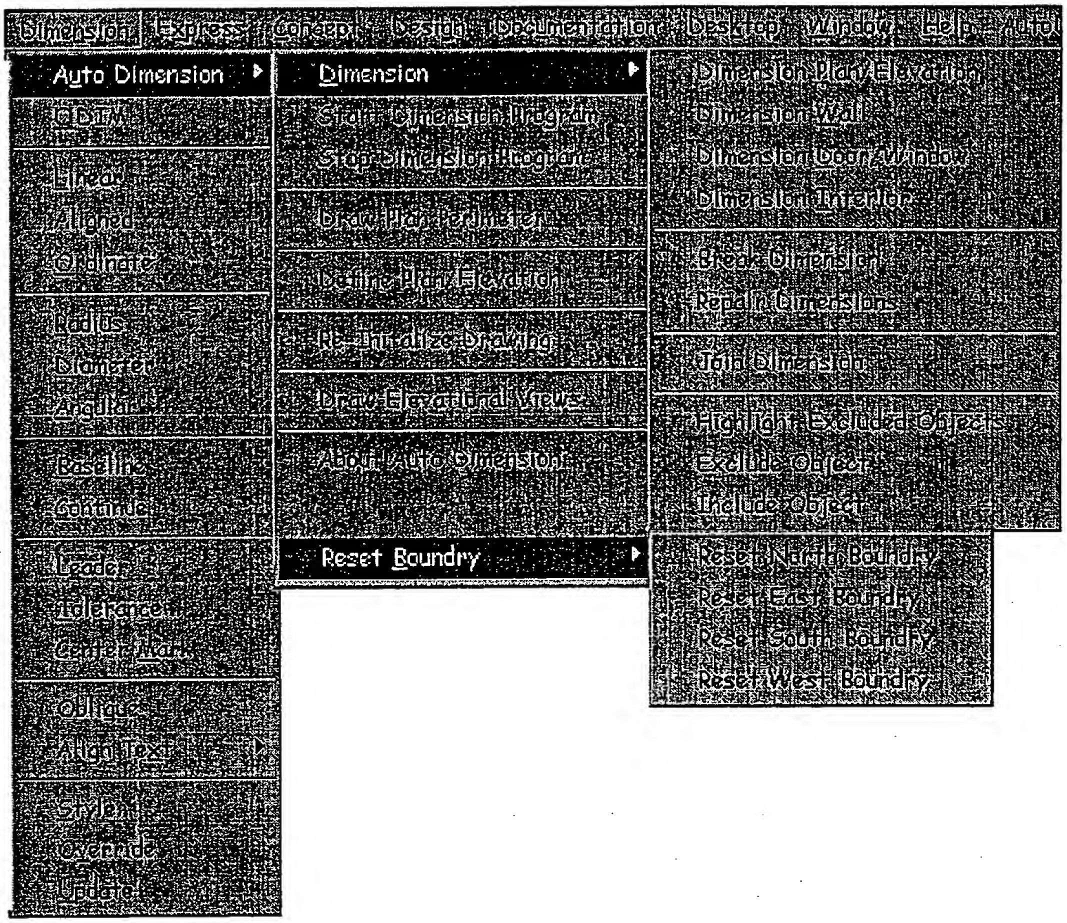


If **OK** is selected the program will automatically select the first three input polygons on the template and attempt to rebuild all the connections between the walls. Due to the nature of the program it will at this time re-dimension any walls that have had their dimensions altered. In order to avoid this, the walls with altered dimensions must be **Excluded**, which will be described later. After clicking **OK** and restoring the wall relationships the program is initialized. AutoDim ENABLED INITIALIZED will be displayed in the menu bar and all commands will be available and work as designed. If **CANCEL** is selected at the Repair/Restore Dimensions prompt, the program will not try to create associations between walls and dimensions. In this state the user will be able to start drawing and have dimensions drawn in real-time but will not be able to modify any previously created dimensions. The user will also be able to load new drawings and not have them automatically Restored / Repaired.



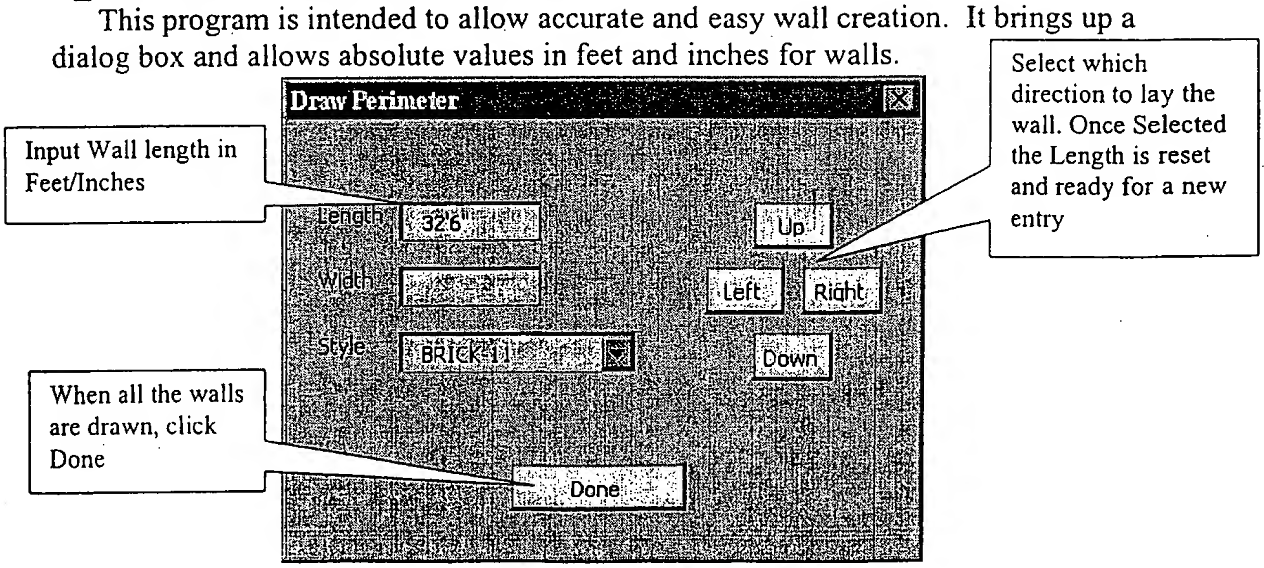
Dimensioning Program:

Overview of commands available



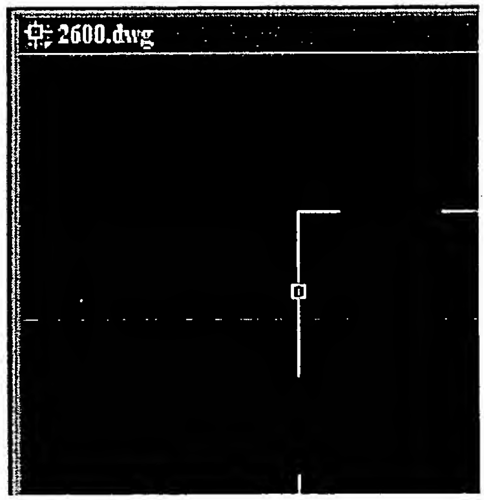
Auto Dimension ▸Draw Plan Perimeter

This program is intended to allow accurate and easy wall creation. It brings up a dialog box and allows absolute values in feet and inches for walls.



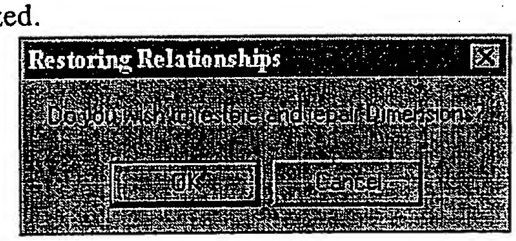
Auto Dimension ▸ Define Plan/Elevation:

Within the RNDesign 'Template' there are cyan polygons to contain the drawn floor plans. On initialization, the Auto Dimension program will find the first three of these and define them as holding a floor plan. It is only within these areas that walls will be related to each other. If you are adding a plan to an area which is not one of the first three you must define this plan.
One you have selected **Define Plan/Elevation** the cursor will change to a box. You must select the polygon by left clicking the mouse. This will add the polygon to the list of valid floor plans.



Auto Dimension ▸ Re-Initialize Drawing

As discussed previously, this command has many functions and many times when it should be used.
If, for whatever reason, the program crashes you must **Re-initialize** the drawing to continue using the auto-dimensioning program - even though the menu bar states that the program is initialized.



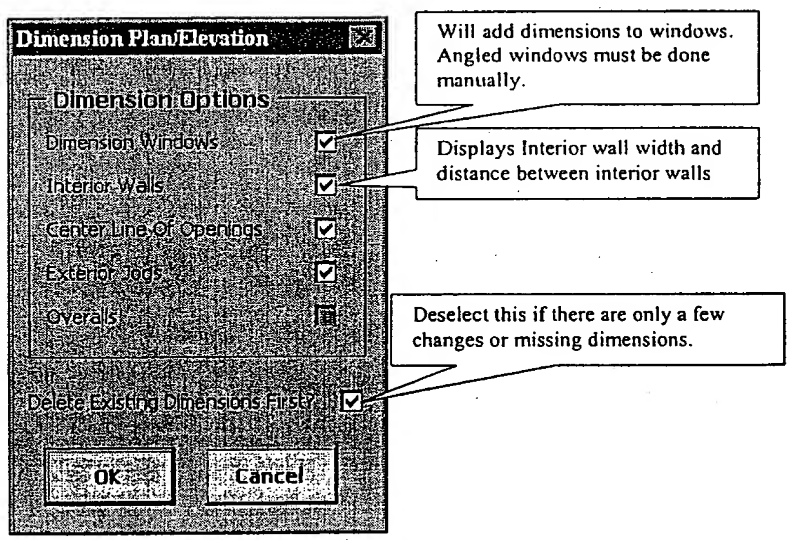
If **OK** is selected the program will automatically select the first three input polygons that are valid on the template and attempt to rebuild all the connections between the walls. Due to the nature of the program it will at this time re-dimension any walls that have had their dimensions altered. In order to avoid this, the walls with altered dimensions must be disabled which will be described later. After clicking **OK** and restoring the wall relationships the program is initialized. AutoDim ENABLED INITIALIZED will be displayed in the menu bar and all commands will be available and work as designed. If **CANCEL** is selected at the Repair/Restore Dimensions prompt the program will not try to create association between walls and dimensions. In this state the user will be able to start drawing and have dimensions drawn in real-time but will not be able to modify any previously created dimensions. The user will also be able to load new drawings and not have them automatically Restored / Repaired.

Auto Dimension ▸ Reset Boundary

The Reset Boundary command will allow the dimensions to be re-drawn for a specified orientation. This is useful if the dimensions are drawn too close or too far from their respective walls.
Select **Reset Boundary** then select a wall or line that corresponds to the dimension strings that are to be reset. The Dimensions will then be redrawn at the new distance. If for example, you have a porch extending past the farthest wall, the dimension strings may be too close or overlap the porch. Resetting the boundary will allow all the dimension strings to be moved at once without disabling the program.

Auto Dimension ▸ Dimension ▸ Dimension Plan/Elevation

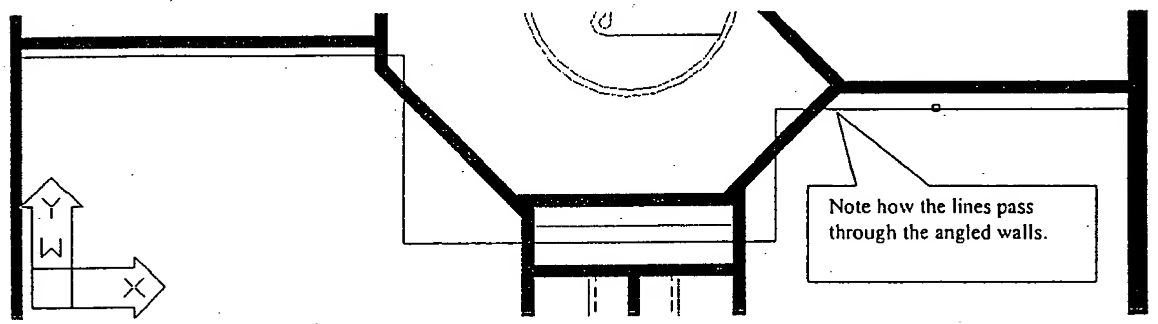
A.K.A. The Magic Button
If a plan has been drawn and dimensions have not been added this command will create all levels of dimensions except for internal dimensions in one step.
Select command and you will be prompted to **'Click point inside elevation to dimension:'**. Simply select any point within the floor plan box which is to be dimensioned. The program will display a dialog box to further clarify what level of dimensioning you wish.



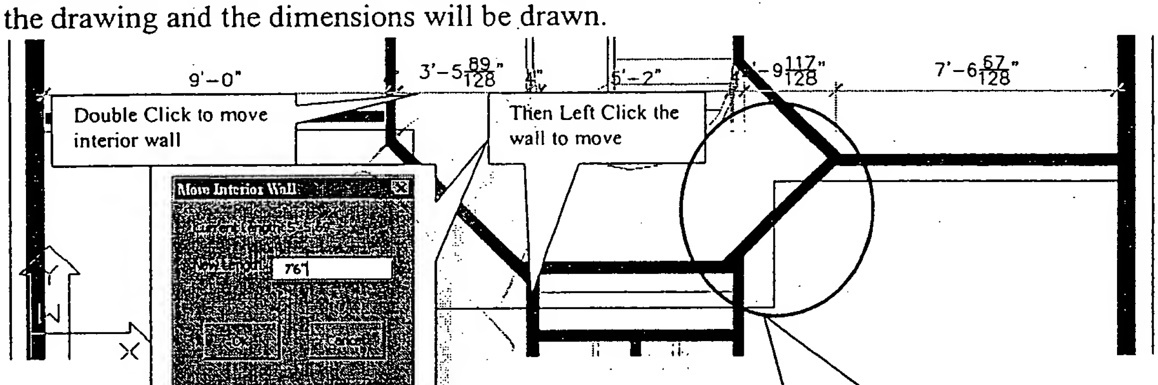
Auto Dimension ▸ Dimension ▸ Dimension Wall (Door/Window)
(*See next page for Illustration*)
Both commands are similar in execution and explanation. Select command and then select the wall or window/door that needs to be dimensioned by clicking on the object.
When dimensioning walls, in the command line the program will display the orientation of the wall being dimensioned and the number of intersecting walls. **'Dimensioning Wall** (4/2)' means that the orientation of the wall is 4 (West wall) and there are two intersecting walls. Sometimes it may show that there are more intersecting walls than are visible. This can cause severe performance degradation. However, **Re-Initializing** the drawing can solve it. Remember to **Exclude** any walls that have custom dimensions associated with them before re-initializing.

Auto Dimension ▸ Dimension ▸ Dimension Interior

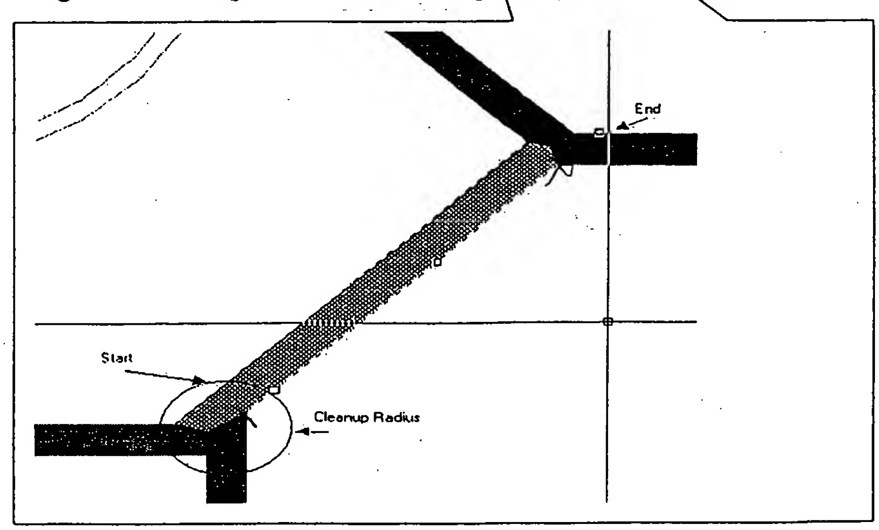
Before dimensioning the interior you must draw a PolyLine through the walls that are to be included in the interior dimension string. You should end the PolyLine within an Exterior wall (not at the edge). When dealing with angled walls, pass the line through the angled wall as shown in the following figure.



You will then be prompted to specify the orientation (North/South/East/West) of the dimension string relative to the wall. You may use a single letter to represent the orientation. Once you have typed a letter and hit Enter, you must then pick the point where the dimension string will be drawn from. **Left click** on any appropriate spot on the drawing and the dimensions will be drawn.



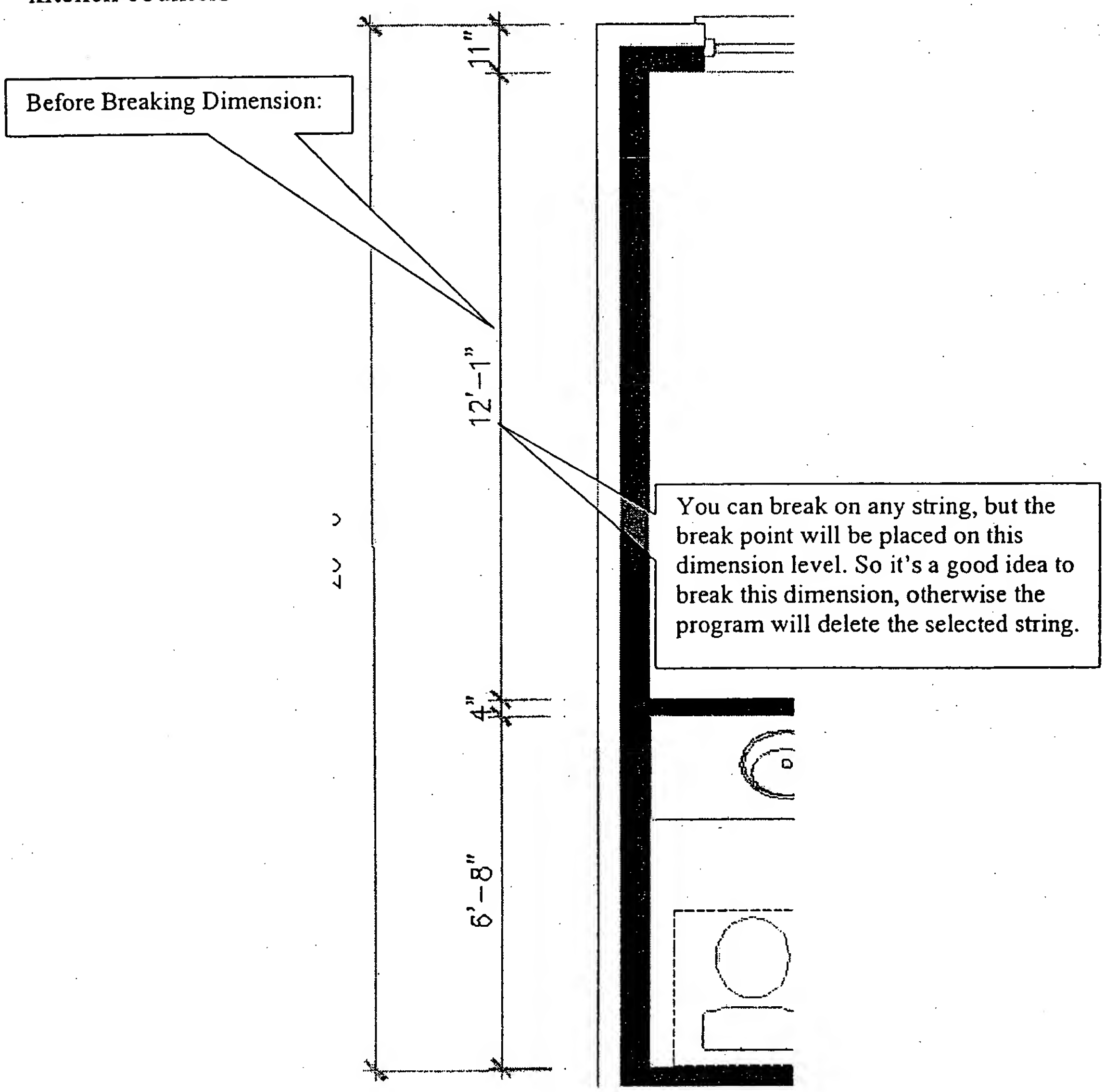
Due to the cleanup function on AutoCAD 2000, often dimensions of angled walls are not whole numbers. This is because of where the walls intersect each other. Careful attention must be paid to angled walls to get dimension strings to appear properly.



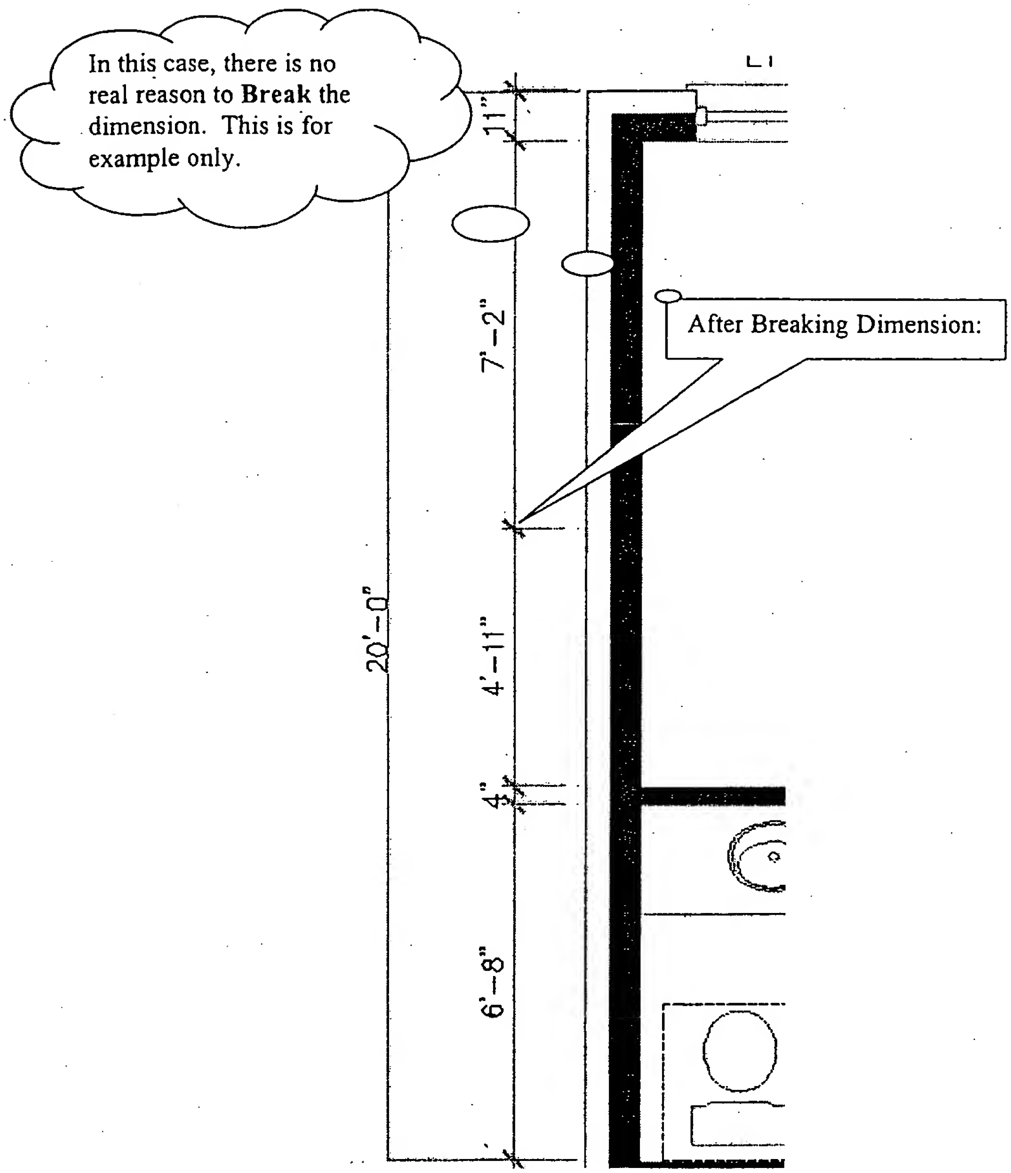
In order to move an internal wall a specified distance, simply **double click** on the dimension you wish to change, and then **left click** on the wall that is to be moved. You will then be prompted to input the new distance, when **OK** is selected, the wall will be moved and dimensions will be re-applied. With angled walls, some cleanup may be required.

Auto Dimension ▸ Dimension ▸ Break Dimension

This command is used to insert custom break points into exterior dimension strings where the program has failed to automatically do so, or where no wall exists such as kitchen counters



Breaking Dimensions Continued…

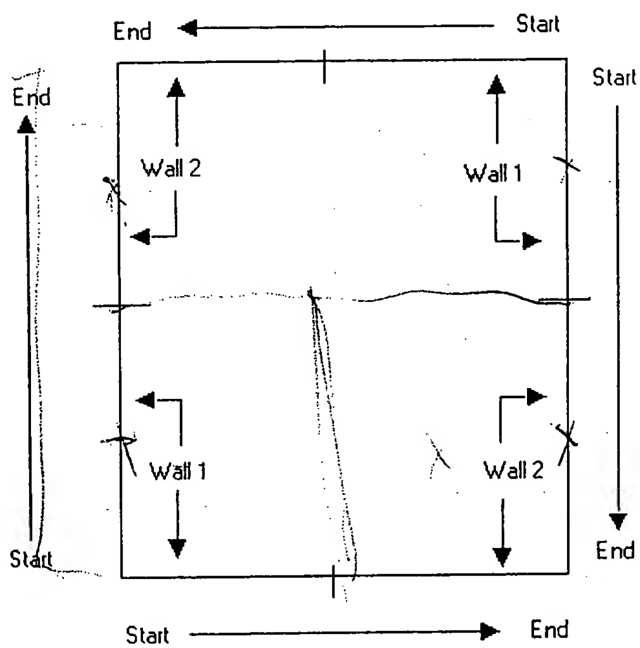


Auto Dimension ▸ Dimension ▸ Repair Dimensions

Simply select the command and select the wall that has broken dimensions associated with it to remove the break and re-dimension the wall, putting it back into its original state.

Auto Dimension ▸ Dimension ▸ Join Dimension

When designing houses, quite often there are situations where there will be a change in wall width along a wall. In AutoCAD, this will necessitate the joining of two wall objects along the same axis. Due to its nature, the program will see these two walls and dimension each separately. However, when plotting the designs, there should not be a break along the wall. This command will remove the break point and string a dimension the length of the two joining walls.
You must select the walls to be joined in a specific pattern for the command to work correctly.
The pattern is as follows, with the Start and End Wall being displayed as such:



If the pattern is not followed, a Zero length dimension will be added. Undo and try again. When finished, **Exclude** the walls changed to protect from further cleanup

Auto Dimension ▸ Dimension ▸ Highlight Excluded Objects

This command will search through all the walls in the drawing and highlight the ones that are excluded from dimensioning. This is the only way to determine which walls are excluded. (See explanation or excluding walls in next section)

Auto Dimension ▸ Dimension ▸ Exclude Object

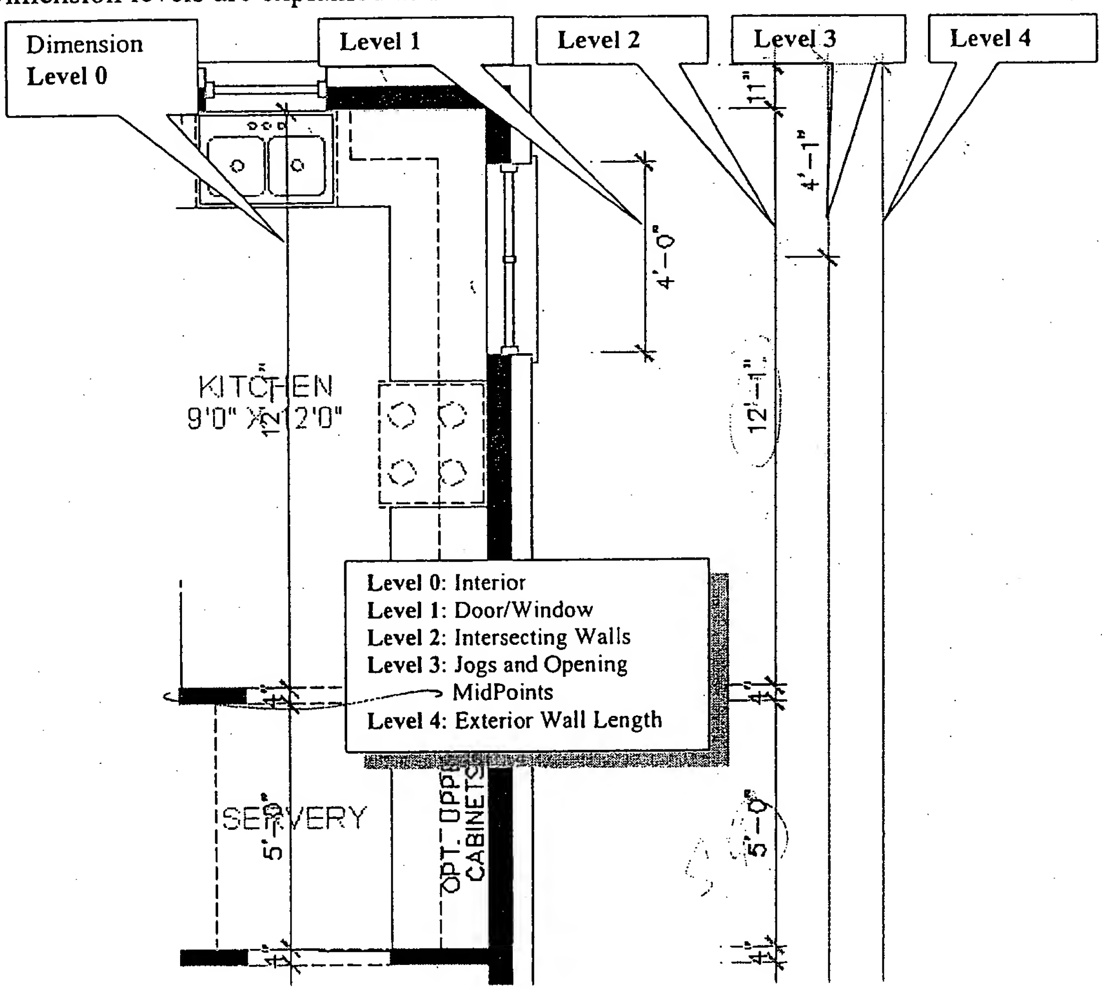
The Auto Dimensioning program does not account for 100% of the dimensioning of a drawing (such as 45° walls). Sometimes it will be necessary to manually modify or add dimensions to a wall. When this happens, the Auto Dimensioning program will remove all manually added or modified dimensions when the drawing is re-initialized. To avoid this problem, **Exclude** the wall when changing or adding dimensions to it and the program will skip over it when any dimensioning procedure is called. Select **Exclude Object** and **left click** on the wall to be excluded.

Auto Dimension ▸ Dimension ▸ Include Object

It may be necessary to **Include** an object that was excluded. To do this, run the Highlight Excluded Objects command to display the walls that are excluded, then run the **Include Object** command, select on the wall, and it will un-highlight as it is selected.

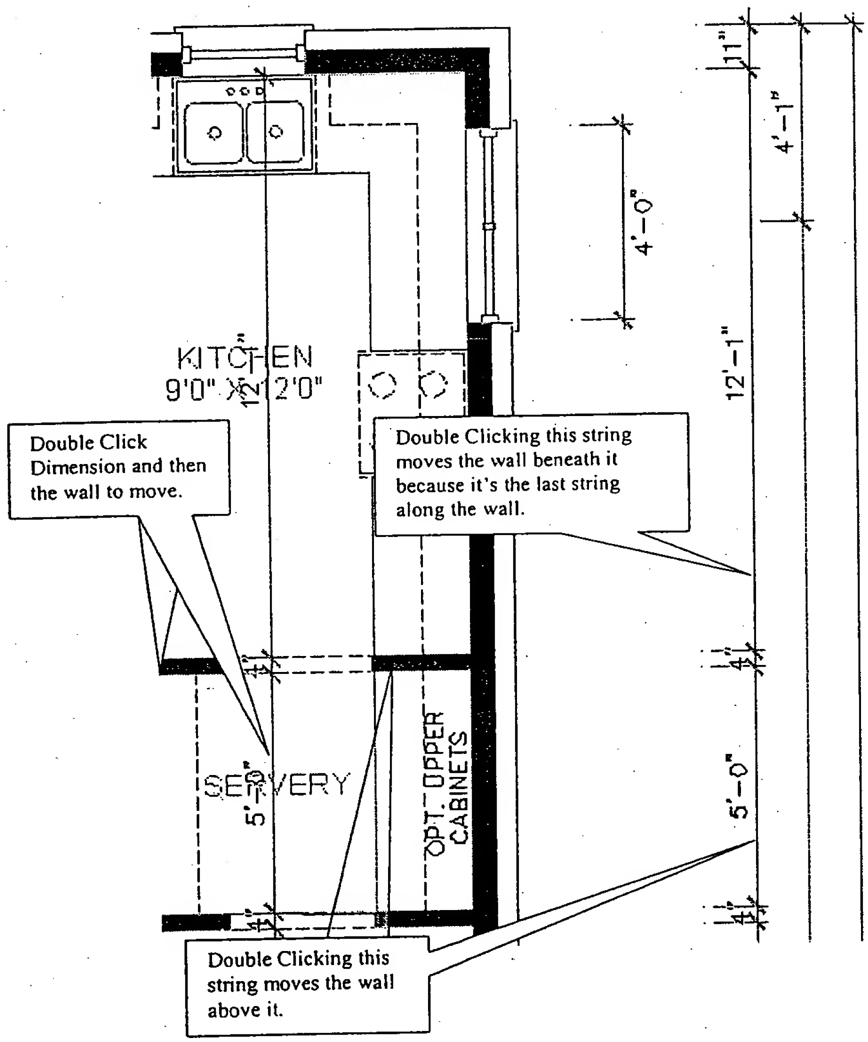
Miscellaneous: Moving Exterior walls via dimension strings.

You can stretch or compact exterior walls by double clicking on the exterior dimension strings. To move an exterior wall you should double click on the 4th level string and then select the appropriate intersecting wall to move.
Dimension levels are explained as follows:



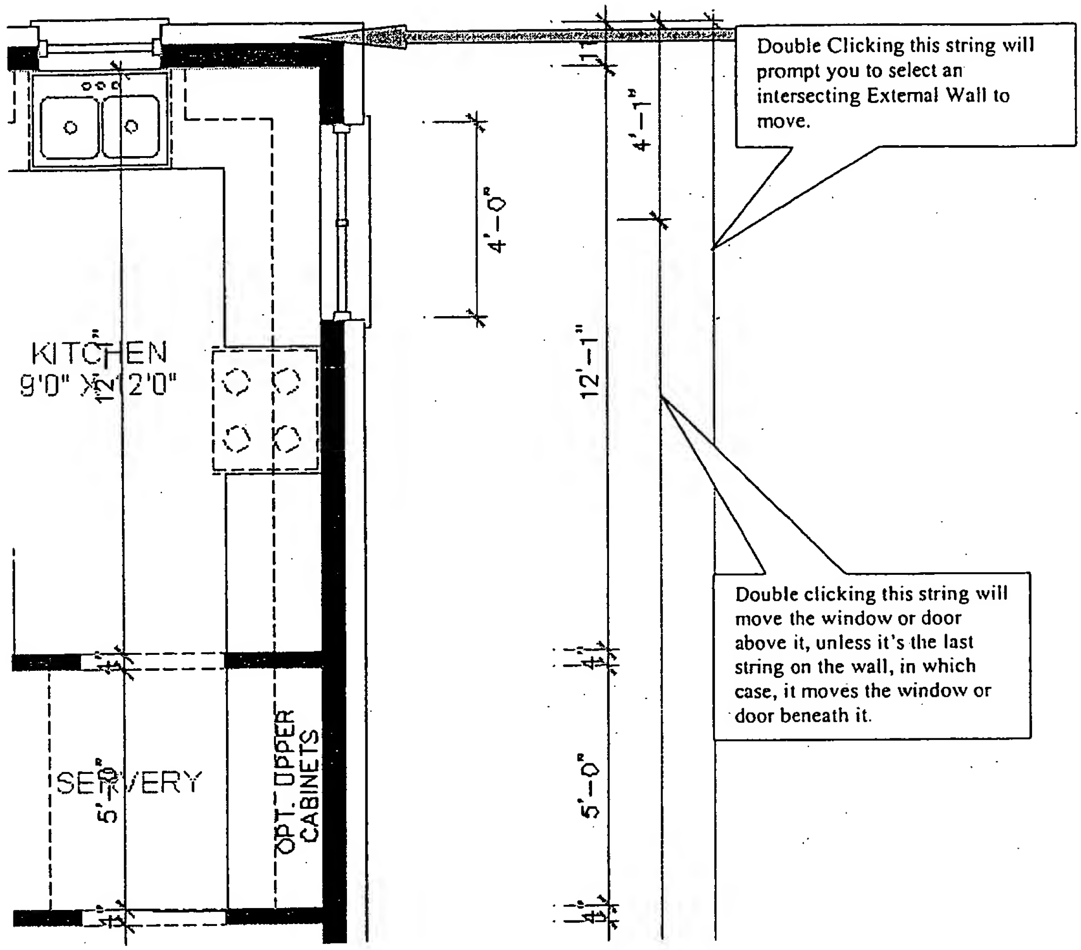
Continued…

Dimension Levels 0 to 2:



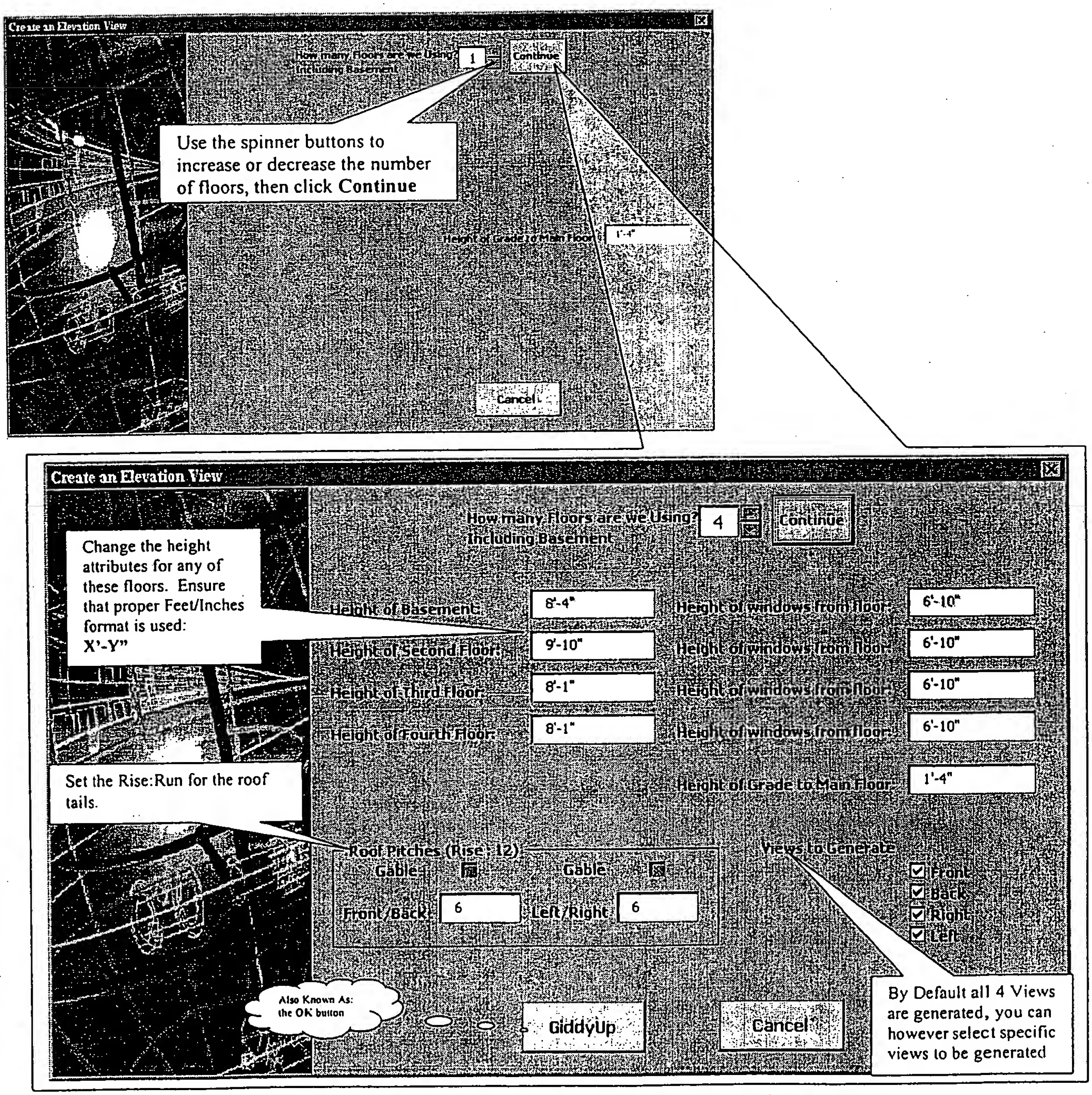
Continued…

Dimension Levels 3 to 4…



Auto Dimension ▸ Draw Elevational Views:

As it sounds, the purpose of this program is to create from one to four elevational views of up to four floor plans. When selected, a dialog box appears asking the user to input the number of floors (including the basement) that are to be elevated. You can either directly input the number or use the spinner buttons to increase/decrease the number of floors. Once **Continue** is selected the floor information is displayed to the user. The number of floors can be changed at any time; selecting **Continue** will dynamically change the number of floors available for editing.

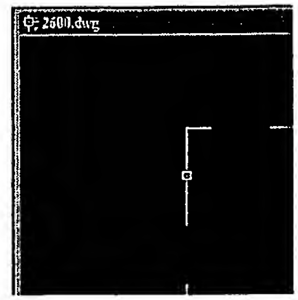


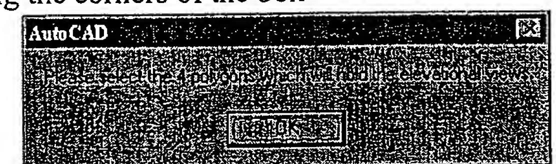
It is important to note that the format for entering height data into the text boxes must be in the format **X'-Y"** even if the floor is 9 feet even, you must enter 0 inches.

When selecting the Roof Pitches, the valid ranges are from 1:12 to 12:12. The Run of 12 is assumed and need not be entered.

Deselect the check boxes for the views that are not to be generated. By default all four views are generated. This is useful for generating Alternate floor plan views where only one or two changes have been made.

Once the **GiddyUp** button has been selected you will be asked to select the 4 polygons which are to be used in creating the elevational views. It is important to note that even if you are creating only one view you must still select 4 polygons.
Select these in the same manner as in the Define Elevation/Plan, by selecting the corners of the box

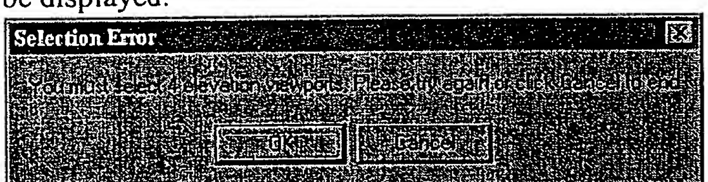




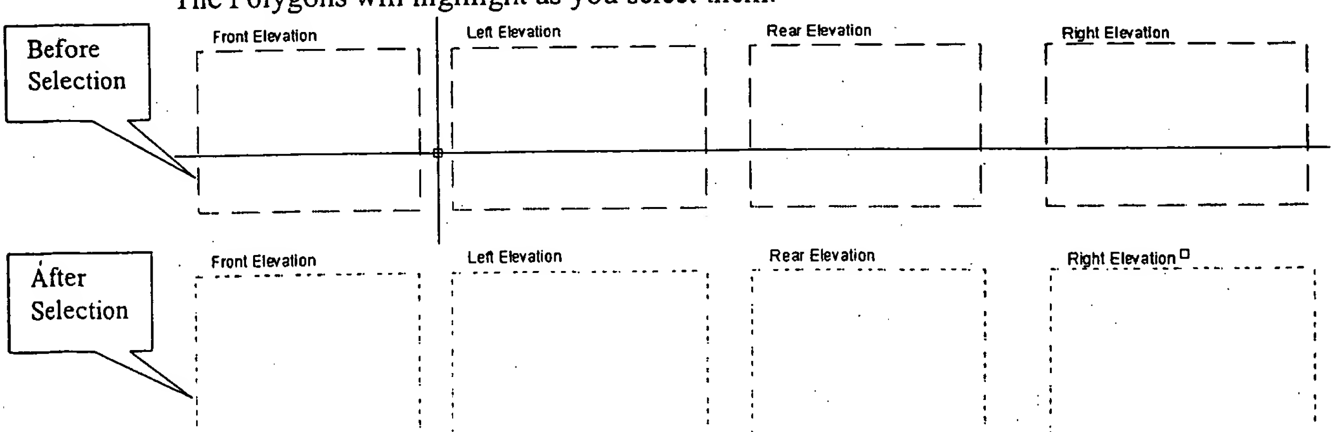
Click OK and the cursor will change to a select cursor. You must select the polygons in the following order of display:

Front, Left, Rear, Right

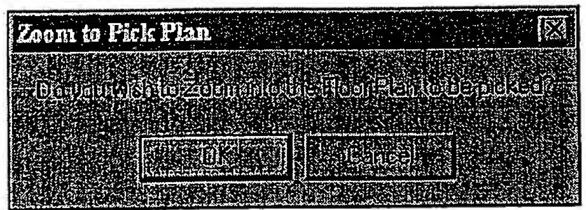
This is the order in which the views are generated.
If you hit **Esc.** or less than 4 polygons while selecting the polygons, the following dialog box will be displayed:



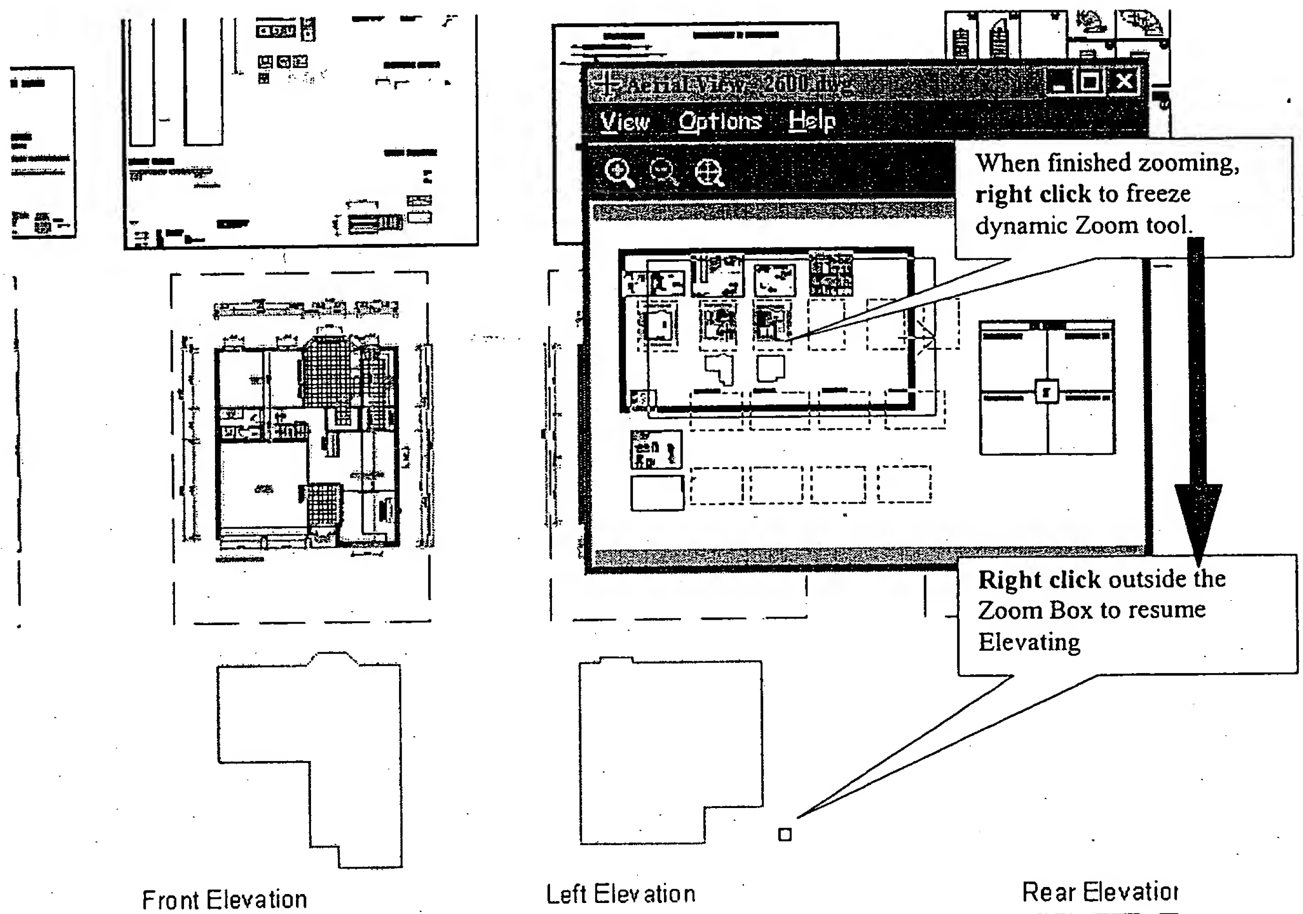
By selecting **Cancel** at this stage you can exit the program and resume normal AutoCAD functions, or reset the selection set that you have made and start over by selecting **OK**.
The Polygons will highlight as you select them.



When all four polygons have been selected, **right click** to continue.
You will then be asked if you wish to Zoom into the floor to be picked.

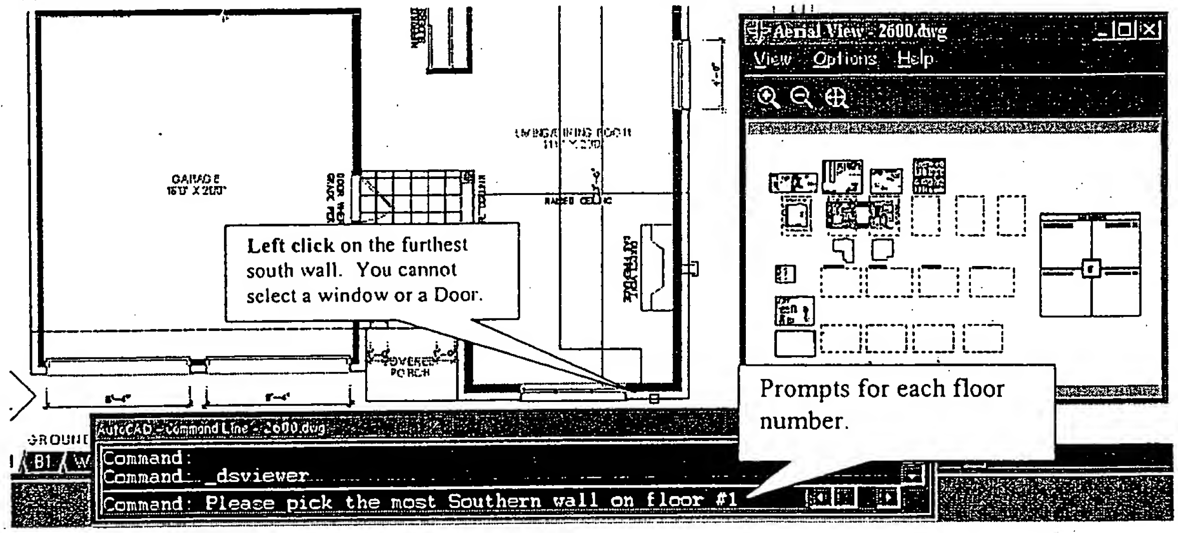


It is a good idea to select **OK** if you are zoomed out far enough to see all four elevational views, as it will be difficult to select a specific wall at that distance.
If **OK** is selected the 'Arial View' zoom window will appear which will allow you to use the dynamic Zoom tool. If you already have the zoom window open click **Cancel**, otherwise the 'Arial View' window will be removed.

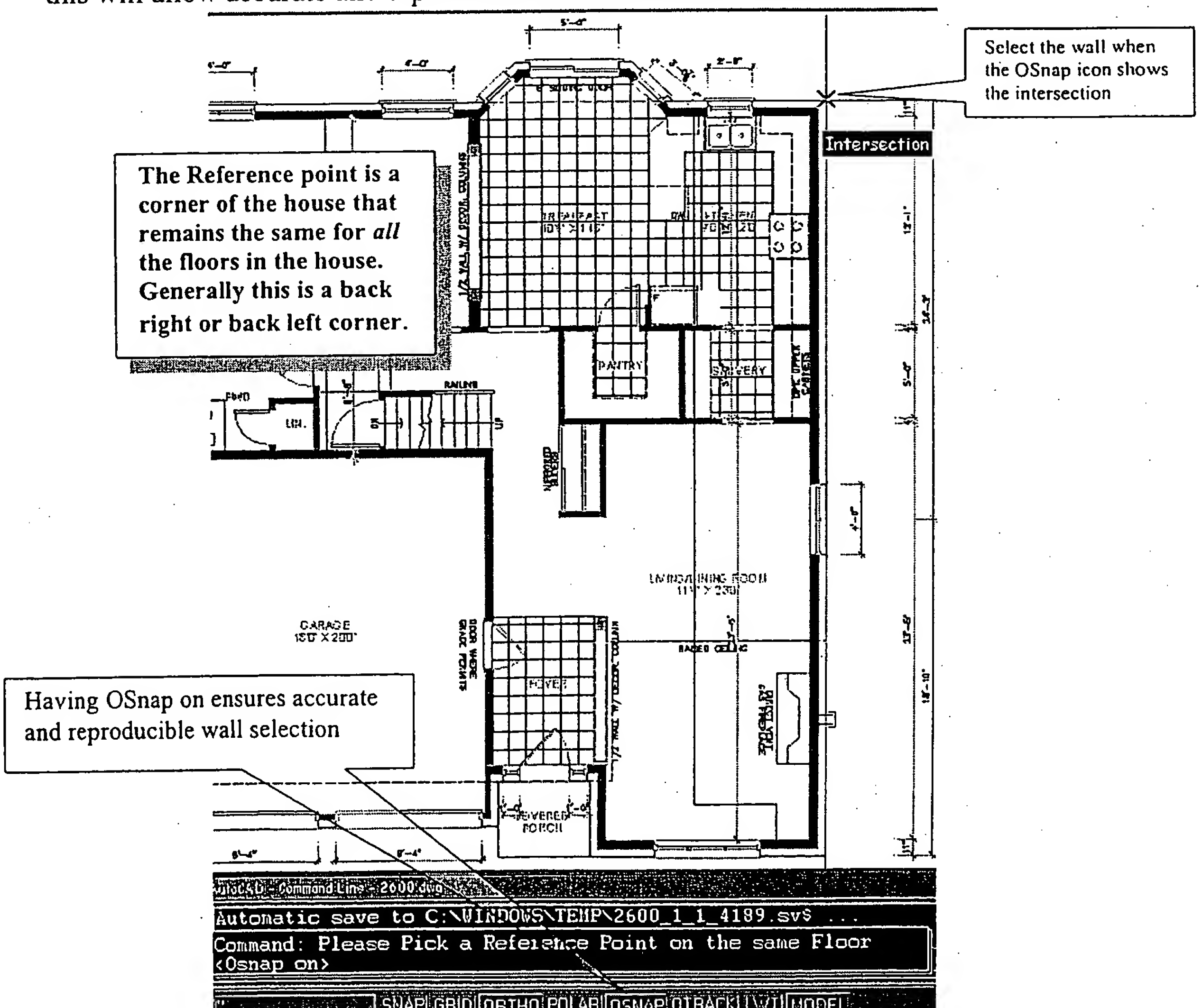


Once the proper zoom level has been attained, **right click** within the 'Arial View' window and then **left click** in the main window. You can at any time scroll around the drawing by using the scroll bars. You **cannot**, however, execute any command in the command line while running the elevational program. Doing so will disrupt the normal execution of the program, resulting in the need to re-start.

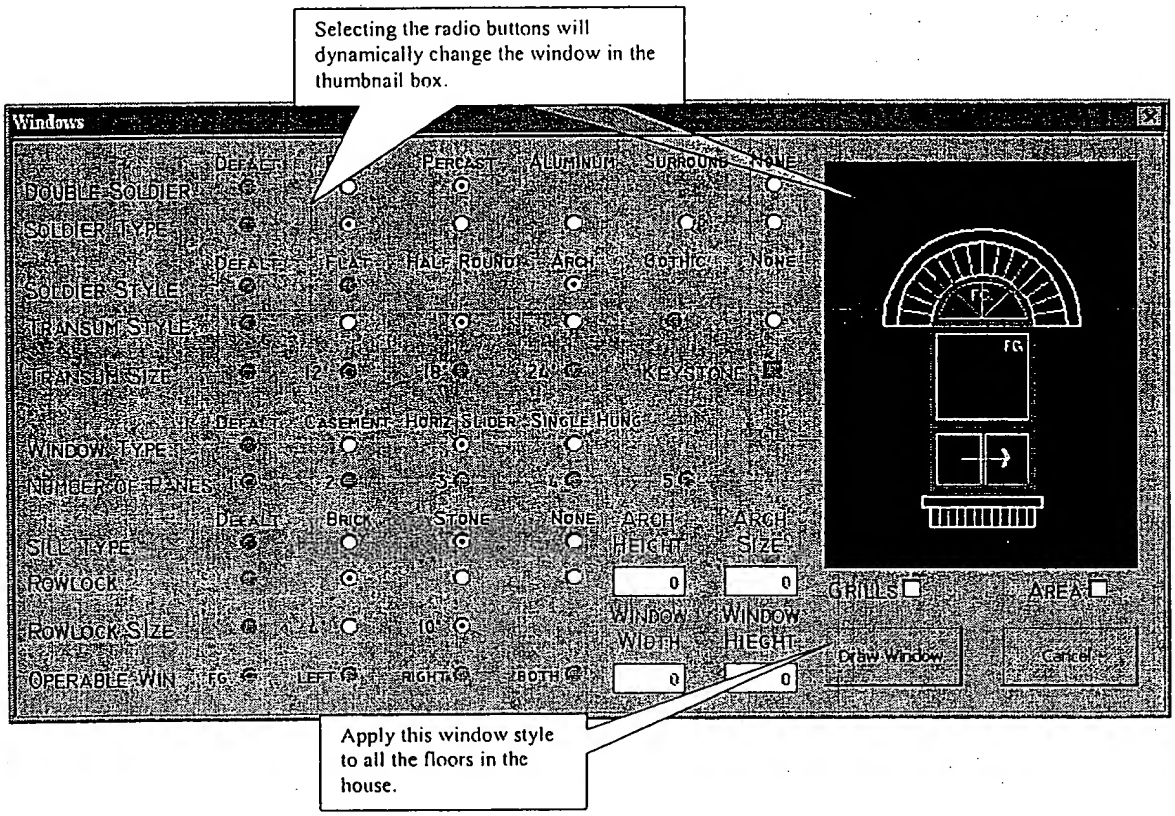
You will then be asked in the Command Line window to select the farthest South wall on each floor.



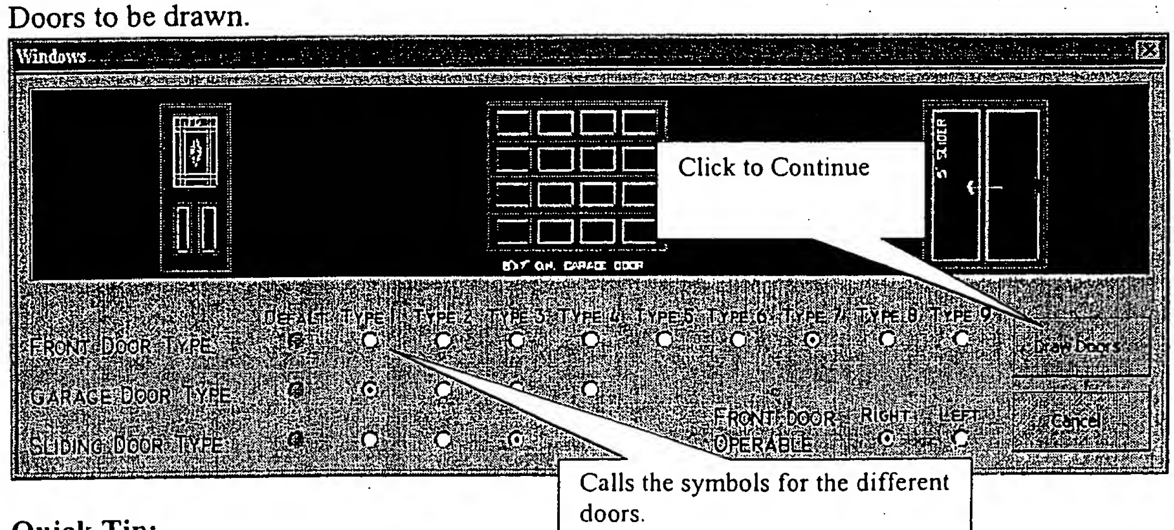
You must **left click** on this wall. When the wall has been selected, the next step is to select an appropriate Reference Point. It is a good idea to have OSnap enabled, as this will allow accurate and reproducible selection of the exterior wall.



Once you have selected a reference point for the first floor (basement), a dialogue box will be displayed. This will prompt you to select the window type for the house. Initially all the windows will be drawn exactly the same, but all windows can be modified at a later time (with a double click) to suit the specific needs of each wall and floor in the house. It is a good idea to set the variables to the window type that is the most common for your elevation (usually the sides or rear).



After the windows are set up properly, and the 'Draw Window' button has been depressed, another dialogue box will display. This determines the different types of Doors to be drawn.

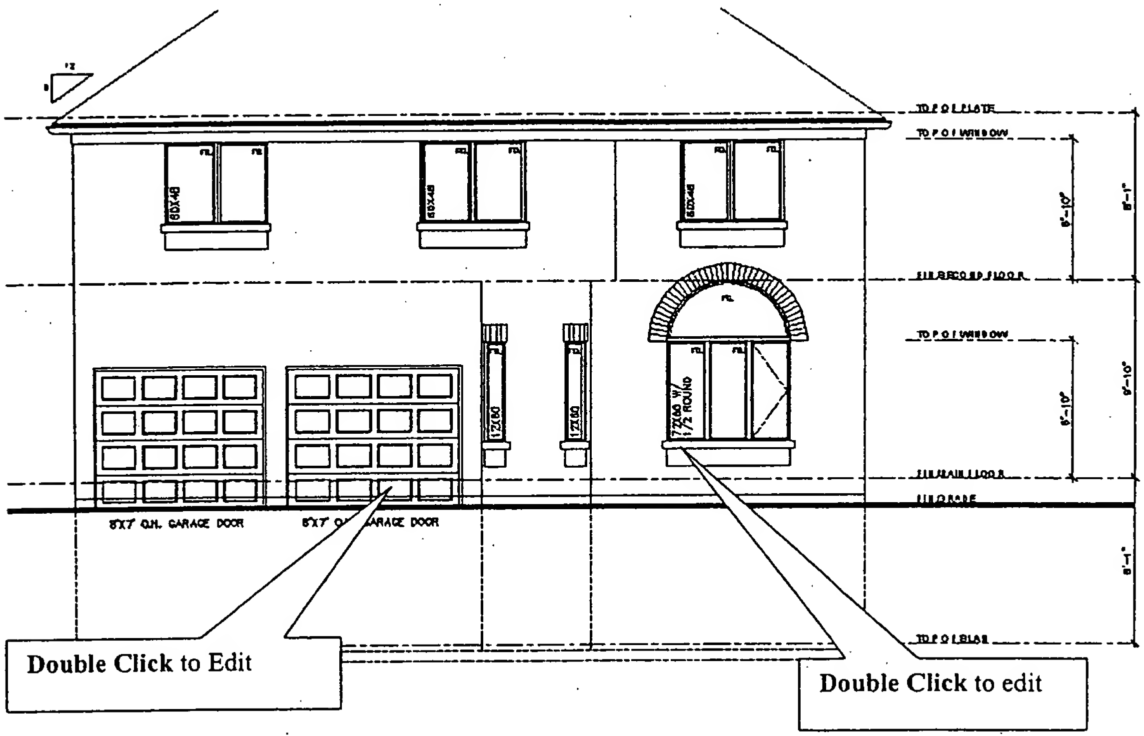


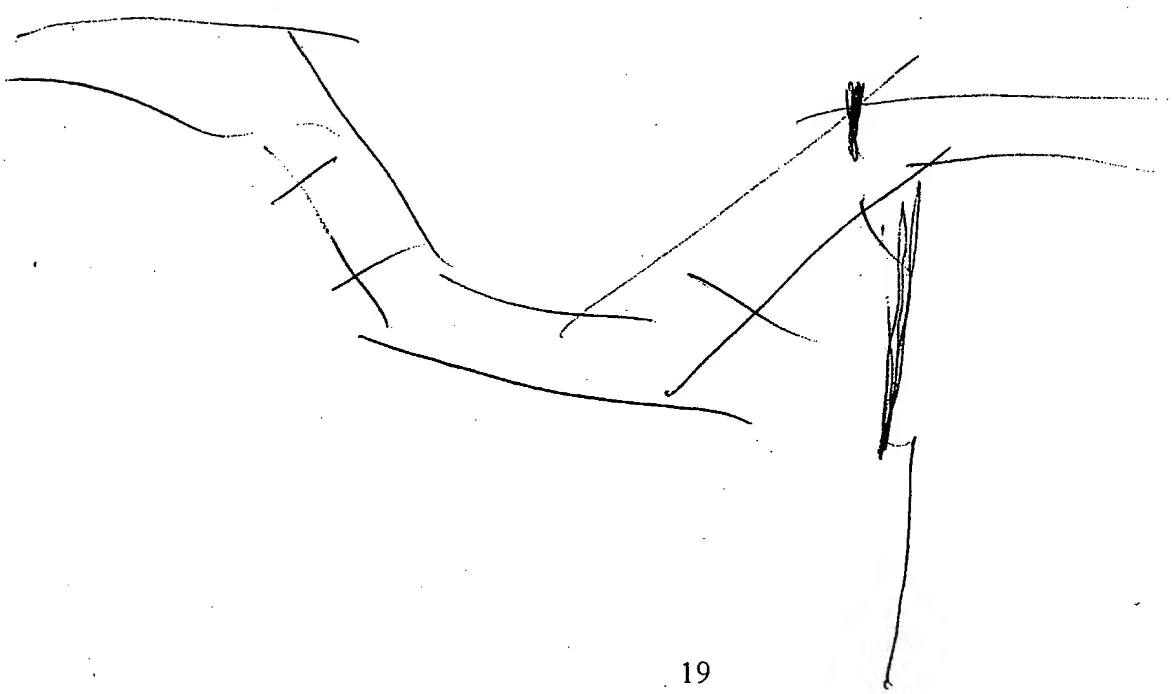
Quick Tip:
To edit Windows, and doors, double click them.

Once this has been done, the elevation for a single floor will be drawn. The program will ask once again, for the farthest south wall and a reference point, but will no longer display window/door dialog boxes.

When the final floor has been drawn, Eaves and roof tails will be drawn. Execution has been completed. You must wait for the screen to completely refresh before continuing.

Front Elevation: (As finished by the program)





Quick Tips:

- Ensure that the program is disabled (**Auto Dimension ▸ Stop Dimension Program**)if you wish to load a drawing and not have it re-dimensioned.

- In order to increase execution speed of AutoCAD, several commands will cause the dimensioning program to unload; these are:
  Offset
  Stretch (including Grip Stretching an object)
  Copy (including Copy Clip)

- You should wait to execute these commands until it is not important to have the dimensioning program running.

- If you have manually modified the dimensions, **Exclude** the walls that are affected before **Re-Initializing** the drawing. You can view which walls are excluded by executing the **Show Excluded Walls** command. This will be described in more detail further in the document.

- When Elevating a group of floor plans, it is **essential that all walls properly join**. Do not rely on the Cleanup Radius property to join walls, as this merely shows the walls joined without actually joining them. If you fail to do this, your elevation will not be correct!

- When entering height data for windows and walls in the '**Create Elevation View**' dialog, it is important that the data be in the following format:
  X'-Y" (even if the floor is 9 feet even, you must enter 0 inches)

- If you are creating only one elevational view, you must still select four polygons. They must be selected in the following order: **FRONT, LEFT, REAR, RIGHT**

- When creating elevational views of a drawing, you should not execute any command line command. This will result in a disruption of normal program execution, resulting in the need to re-start.

- When selecting a reference point, having **OSnap** on will ensure accurate and reproducible wall selection

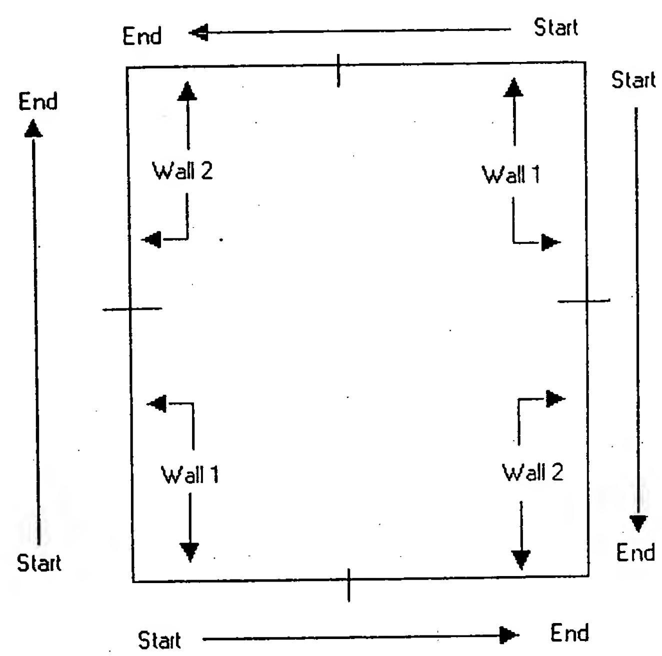
- To edit Windows once they are drawn, **Double Click** on the window to be edited in the elevational view.

- To edit Doors once they are drawn, **Double Click** on the door to be edited in the elevational view.

- When adding a non-standard window, such as a bow window, add an opening into the wall rather than breaking a wall into two walls. If there is no opening, the program will terminate.

- When Dimensioning a Wall the Command Line will show the orientation of the wall and the number of intersecting walls as: **'Dimensioning Wall (4/2)'**. Sometimes it may show there are more intersecting walls than are visible as: **'Dimensioning Wall (4/16)'**. If this happens, there will be significant performance degradation. It can be fixed by **Re-Initializing** the drawing. Remember to **Exclude** any walls with custom dimensions associated to it.

- When **Joining Dimensions** you must select the walls to be joined in a specific pattern. The pattern is as follows:



SCHEDULE "B"

AUTOMATIC ADAPTIVE DIMENSIONING FOR CAD SOFTWARE

Field of the Invention

This invention relates to computer software. In particular, this invention relates to an improvement in computer aided design (CAD) software.

Background of the Invention

There are many types of computer aided design (CAD) software which assist in architectural design and drafting. Such software is widely used, as it considerably simplifies the task of drafting plans to scale with such annotations as are required for the needs of the user.

One of the advantages of CAD software is a feature whereby an object can have dimension annotations associated with the object, including dimension lines, extension lines, symbols of termination (e.g. arrowheads, architectural ticks) and dimension text, created automatically. Thus, the dimension can be automatically created for an object as the object is drawn. This considerably simplifies the annotation of the drawing, which had previously had been a very time consuming process.

Some CAD programs allow manual associative dimensioning, by which a dimension annotation can be manually associated with an object, and thereafter if the object is moved the dimension annotation adjusts automatically with the object. This also facilitates the annotation of drawings, however it requires that the user manually attach the dimension to the object in order for changes in the object to be reflected in the associated dimension annotation. Furthermore, if the object is broken, for example if another object is interposed in or superposed onto an intermediate point of the existing object, the associative dimensioning cannot accommodate the new object and new dimensions, so new dimension annotations corresponding to the new object must be manually added and new associations must be established between the existing dimension annotation and the remaining portions of the existing object. This is a time consuming process, particularly during the modification stages of CAD drafting.

For example, adding a window to an existing wall in a CAD drawing requires that the window be inserted at the intended position, that the existing dimension annotations be deleted and that new extension lines, dimension lines, termination symbols and dimension text be created to reflect the new segmentation of the object and/or the addition of any new object (or the removal of an existing object).

It would accordingly be advantageous if dimension annotations were created automatically as objects are created, and automatically associated with the objects as they are created. It would further be advantageous if dimension annotations would change automatically to accommodate any change to the existing objects, such as a new object inserted into a selected position relative to the existing objects or the deletion of an object from a group of objects.

<u>Summary of the Invention</u>

The present invention overcomes these disadvantages by providing automatic adaptive dimensioning in a CAD software program. According to the invention, dimension annotations are created by the CAD program automatically as an object is drawn and automatically associated with the target object. Thereafter, changing the length of the target object automatically changes the associated dimension annotation, or alternatively, changing the associated dimension annotation automatically changes the length of the target object. Further, changing the dimension annotation associated with an adjacent object automatically changes the position of the target object.

Moreover, when another object is inserted into an intermediate position of an existing object, the automatic adaptive dimensioning feature of the invention automatically creates dimension annotations corresponding to the position of the new object relative to the existing object; likewise, the new object can be automatically positioned in relation to the existing object by specifying interposition dimensions or segment lengths in the existing dimension annotations. Thereafter, any changes to the lengths or relative positions of the objects will automatically change the associated dimension annotations, and any changes made to the associated dimension annotations will automatically change the lengths and/or relative positions of the objects.

Incorporating the automatic adaptive dimensioning feature of the invention into a CAD program accordingly substantially decreases the production time of architectural drawings. The commensurate savings in labour, particularly in the input, documentation and modification stages of drawing preparation, provides a considerable advantage over conventional CAD drawing programs.

These and other features of the invention will be apparent from the detailed description which follows.

The present invention thus provides a method of annotating a computer aided design drawing, comprising the steps of a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, b. creating a target object by selecting a length of the target object; and c. automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

The present invention further provides a computer program product for use with a computer, the computer program product comprising a computer usable medium having computer readable program code means embodied in said medium for annotating a computer aided design drawing, said computer program product having computer readable program code means for setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, computer readable program code means for creating a target object by selecting a length of the target object; and computer readable program code means for automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension

annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

The present invention further provides a program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for annotating a computer aided design drawing, said method steps comprising: a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols, b. creating a target object by selecting a length of the target object; and c. automatically generating dimension annotations corresponding to the target object, whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

A further aspect of the invention includes the step of, in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

Brief Description of the Drawings

In drawings which illustrate by way of example only a preferred embodiment of the invention,

Figure 1 is a diagrammatic illustration of objects and associated dimension annotations in a conventional CAD drawing,

Figure 2 is a diagrammatic illustration of an object and associated dimension annotations in a CAD drawing using the method of the invention,

Figure 3 is a diagrammatic illustration of the drawing of Figure 2 after inserting a new object,

Figure 4 is a diagrammatic illustration of the drawing of Figure 3 after inserting a new object,

Figure 5 is a diagrammatic illustration of the drawing of Figure 4 after inserting a new object,

Figure 6 is a diagrammatic illustration of the drawing of Figure 5 after inserting a new object,

Figure 7 is a diagrammatic illustration of the drawing of Figure 6 after inserting a new object,

Figure 8 is a diagrammatic illustration of the drawing of Figure 7 after inserting a new object,

Figure 9 is a diagrammatic illustration of the drawing of Figure 8 after inserting a new object,

Figure 10 is a diagrammatic illustration of the drawing of Figure 9 after moving an existing object, and

Figure 11 is a diagrammatic illustration of the drawing of Figure 10 after deleting an object.

Detailed Description of the Invention

Figure 1 illustrates an architectural drawing by way of example. In a conventional CAD drawing program, line objects representing walls 10 and a windows 12 which are drawn or inserted in the CAD environment. Dimension text 20 specifying the lengths and relative positions of the objects 10, 12 are entered by the user, and in some CAD programs may be thereafter manually associated with each respective object 10, 12, so that a change in the length of the object is automatically reflected in the associated dimension text 20. Extension lines 22 are positioned or picked (selected) by the user for the desired dimension text, and dimension lines 24

and termination symbols 26 such as architectural ticks are either manually created by the user, or generated based on user-defined settings, based on the selected positions of the extension lines 22.

According to the invention, the dimension annotations are automatically created and associated with the respective objects to which they relate, and thereafter these dimension annotations are adaptive. Thus, the interposition or superposition of a new object in or onto an existing object automatically results in new extension lines 22 at the extremities of the new object, parsing of the existing dimension line 24 into segments with selected termination symbols 26, and the repositioning and recalculation of dimension text to accommodate the new object.

In use, to create a horizontal or vertical dimension associated with an object 10, 12, the object dimension text 20 can be selected by clicking, picking or otherwise specifying first and second points representing the ends of the object 10 or 12. In the case of multiple dimension strings, the locations of the dimension lines 24 (for example baseline strings or aligned strings) are also specified by the initial user settings, as are extension lines 22 and dimension text 20, with the selected termination symbols 26, which are thereafter generated automatically by the adaptive dimensioning feature of the invention based on the coordinate positions selected for the object. This feature of the invention also automatically trims or extends the dimensions annotations in response to a change in the size or position of the associated target object.

Thereafter, modifications to the existing objects 10, 12, may be made in two ways:

1. By modifying the length of the target object 8 itself and/or moving the target object to a new position relative to other objects. In this situation the associated dimension annotations automatically change to adapt to the modification of the associated object's dimension and/or position, moving extension lines, arrowheads or other termination symbols, and dimension text as necessary to accommodate the modification.

2. By changing dimension text to specify a new length for the target object 8, and/or changing the dimension text of an adjacent object to reposition the target object. In this case, the length of the object whose associated dimension text has been modified changes to correspond to the modified dimension. If the length of an adjacent object is changed, the target object is repositioned to remain adjacent to the adjacent object.

Specifics of the extension lines 22, alignment of dimension lines 24 (e.g. as aligned or baseline), type of termination symbols (e.g. architectural ticks), size and placement of dimension text 20, and any other desired parameters, are selected as setup parameters by the user before commencing drawing. The CAD drawing will automatically adaptively associate dimension annotations having the predefined parameters with the respective objects as they are inserted, deleted or modified.

Thus, in the example shown as a series of drawing steps in Figures 2 to 11, a target object 8, in Figure 2 being a wall 10a, is inserted into a new CAD drawing by selecting points 11a and 11b. Dimension annotations are automatically created by the method and computer program of the invention, by creating extension lines 22a aligned with the extremities of the target object 10a, creating a dimension line 24a with termination symbols 26a at its ends and creating dimension text 20a adjacent to the dimension line 24a (or as otherwise specified by the user in the setup parameters).

In Figure 3 the target object 8 is a new exterior wall 10b, added to the drawing of Figure 2 by selecting point 11c. Again dimension annotations are automatically created for the target object by aligning extension lines 22b with the extremities of the target object 8, creating a dimension line 24b with termination symbols 26b at its ends and creating dimension text 20b adjacent to the dimension line 24b. When a new target object 8 is created, for example another exterior wall 10c, by selecting point 11d, as shown in Figure 4, in addition to automatically creating dimension annotations for the new exterior wall 10c, the position of the dimension annotations for the previous object are automatically shifted to accommodate the new target object 8.

Figures 5, 6 and 7 each add a further target object 8, in each case an exterior wall 10d, 10e and 10f, by the selection of points 11e, 11f and 11a, respectively, to delimit the exterior of the structure, and in each case dimension annotations are automatically created for each target object 8 as the target object 8 is inserted, by creating extension lines 22d, 22e, 22f aligned with the extremities of the walls 10d, 10e and 10f, creating dimension lines 24d, 24e, 24f with termination symbols 26d, 26e, 26f at their respective ends and creating dimension text 20d, 20e, 20f adjacent to the respective dimension lines 24d, 24e, 24f.

In Figure 8 a target object 8 comprising a partition wall 10g is added to the drawing of Figure 7 by selecting points 11h and 11j. In this case the adaptive feature of the invention automatically creates extension lines 22g at the appropriate points on the existing dimension lines 24a, 24f, parses the existing dimension lines 24a, 24f into segments 24g, and deletes the existing dimension text 20a, 20f and replaces it with new dimension text 20g relating to the newly created dimension line segments 24g. Similarly, when a target object 8 comprising a window 12 is added in Figure 9, the adaptive dimensioning feature of the invention automatically creates a new dimension line 24h (as specified by the user in the setup parameters) at the window 12 having an on-center extension line 22h with associated dimension text 20h and termination symbols 26h.

In Figure 10, the target object 8 is wall 10c adjacent to the wall 10d with the window 12. Wall 10c is repositioned by dragging the wall 10c to a new position from the previous position (shown in phantom lines). The automatic adaptive dimensioning feature of the invention automatically moves all associated extension lines 22b, 22d to align with the repositioned wall 10c, and replaces the existing dimension text 20b, 22d of the resized walls 10b, 10d with new dimension text 20b, 20d reflecting the new position of the wall 10c relative to adjacent objects. The lengths of walls 10b, 10d adjacent to the target object 8 (wall 10c) automatically adjust to the new position of wall 10c.

To complete the drawing, in Figure 11 the partition wall 10g (shown in phantom lines) has been deleted. The automatic adaptive dimensioning feature of the

invention deletes the extension lines 22 previously associated with the partition 10g to reconstitute the original dimension lines 24f, deletes the dimension text 20g of the parsed dimension line segments 24g, and restores the original dimension text 24f (from Figure 7).

Thus, the invention provides an automatic adaptive dimensioning feature in a CAD program which automatically creates and associates dimension annotations as an object is inserted into a drawing, and modifies the dimension annotations as an object is added, deleted or modified in the drawing. The invention thus provides a method of creating and modifying a CAD drawing which considerably simplifies the CAD documentation process.

The automatic adaptive dimensioning feature of the invention can be programmed into CAD software, or can be created as an independent program loaded as a "plug-in" for existing CAD software.

A preferred embodiment of the present invention having been thus described by way of example, variations and modifications will be apparent to those skilled in the art. The invention includes all such variations and modifications as fall within the scope of the appended claims.

I CLAIM:

1. A method of annotating a computer aided design drawing, comprising the steps of

a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols,

b. creating a target object by selecting a length of the target object; and

c. automatically generating dimension annotations corresponding to the target object,

whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

2. The method of claim 1 further including the step:

d. in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

3. A computer program product for use with a computer, the computer program product comprising a computer usable medium having computer readable program code means embodied in said medium for annotating a computer aided design drawing, said computer program product having

computer readable program code means for setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols,

computer readable program code means for creating a target object by selecting a length of the target object; and

computer readable program code means for automatically generating dimension annotations corresponding to the target object,

whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

4. The computer program product of claim 3, further comprising computer readable program code means for in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

5. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for annotating a computer aided design drawing, said method steps comprising:

a. setting parameters of dimension annotations comprising one or more of dimension text, dimension lines, extension lines and termination symbols,

b. creating a target object by a length of the target object; and

c. automatically generating dimension annotations corresponding to the target object,

whereby the dimension annotations are associated with the target object such that in response to a modification of a length or relative position of the target object, the dimension annotations associated with the target object or the dimension

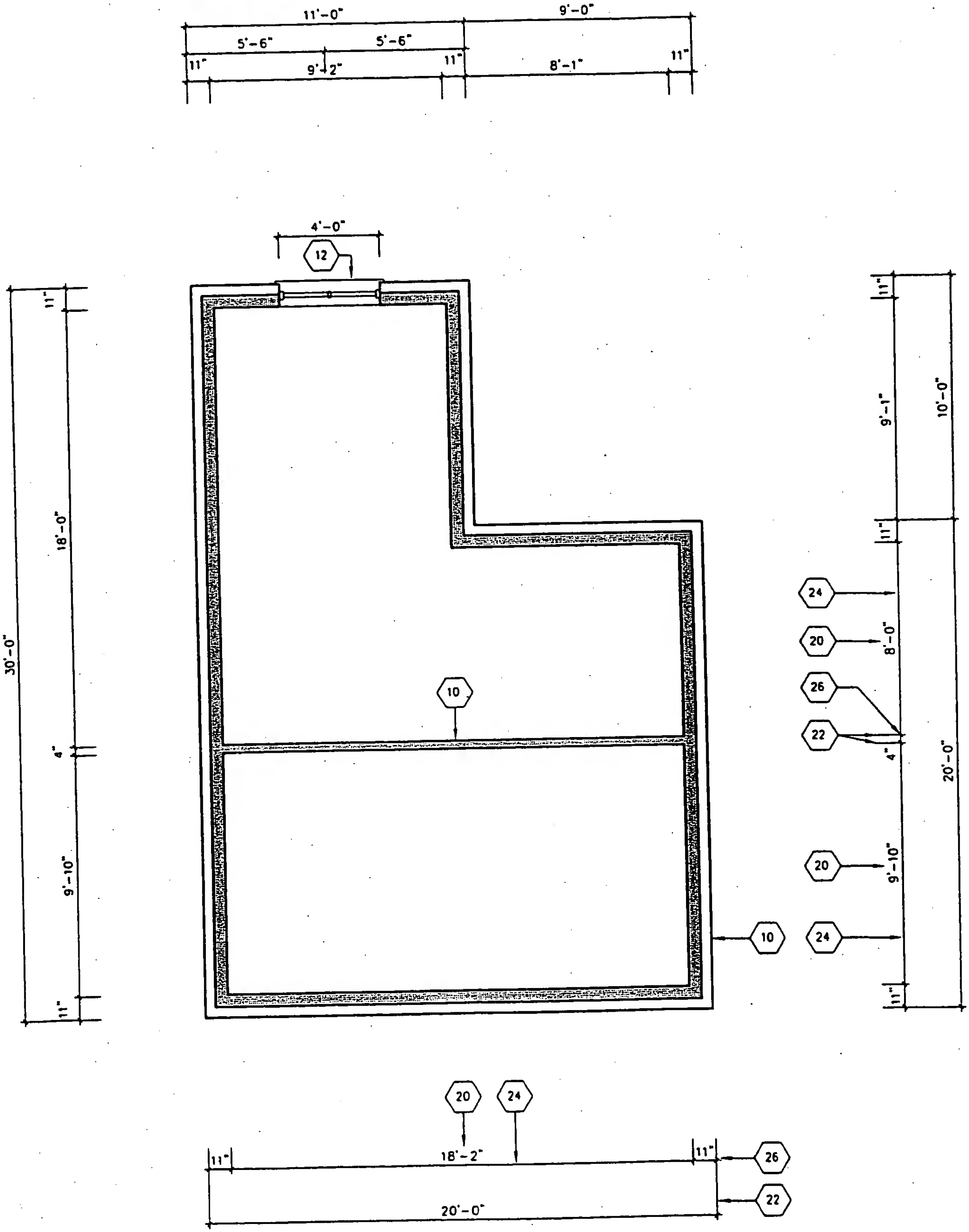
annotation associated with at least one adjacent object, or both, are automatically adjusted to correspond to the modification of the length or relative position of the target object.

6. The program storage device of claim 5, further including a method step comprising:

d. in response to a modification of the dimension annotation associated with the target object or the dimension annotation associated with at least one adjacent object or both, automatically modifying a length or relative position of the target object to correspond to the modification of the dimension annotation.

Abstract

An automatic adaptive dimensioning program for CAD software in which dimension annotations are created by the CAD program automatically as an object is drawn and automatically associated with the object. Thereafter, changing the length of the object automatically changes the associated dimension annotation, or alternatively, changing the associated dimension annotation automatically changes the length of the object. When another object is interposed into or superposed onto an intermediate position of the existing object, the automatic adaptive dimensioning annotation feature of the invention automatically creates dimension annotations corresponding to the position of the new object relative to the existing object. The new object can be automatically positioned in relation to the existing object by specifying interposition dimensions or segment lengths in the dimension annotations.


11'-0"
9'-0"
5'-6"
5'-6"
11"
9'-2"
11"
8'-1"
11"
4'-0"
12
30'-0"
11"
18'-0"
4"
9'-10"
11"
10
10'-0"
11"
9'-1"
11"
24
20
8'-0"
26
22
4"
20'-0"
20
9'-10"
10
24
11"
20
24
11"
18'-2"
11"
26
20'-0"
22

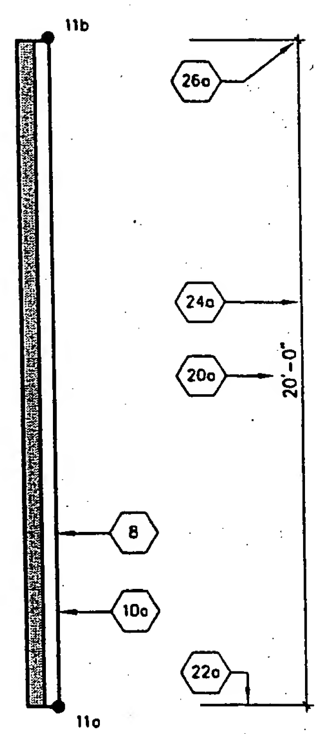


figure 2

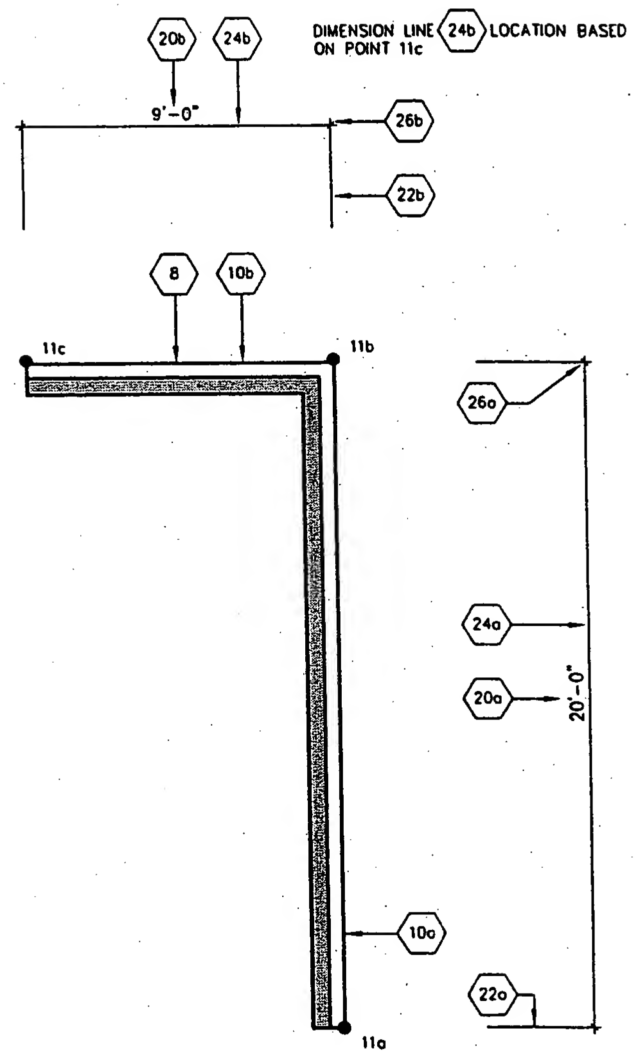
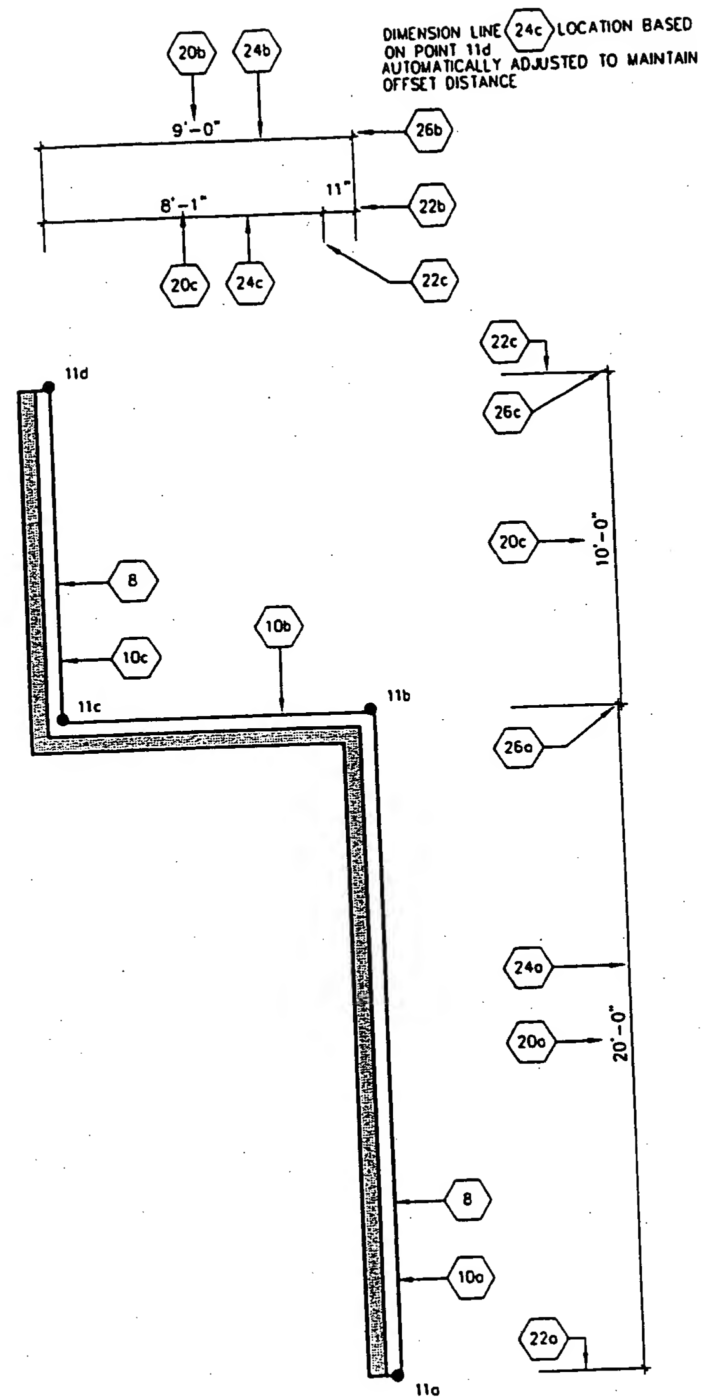
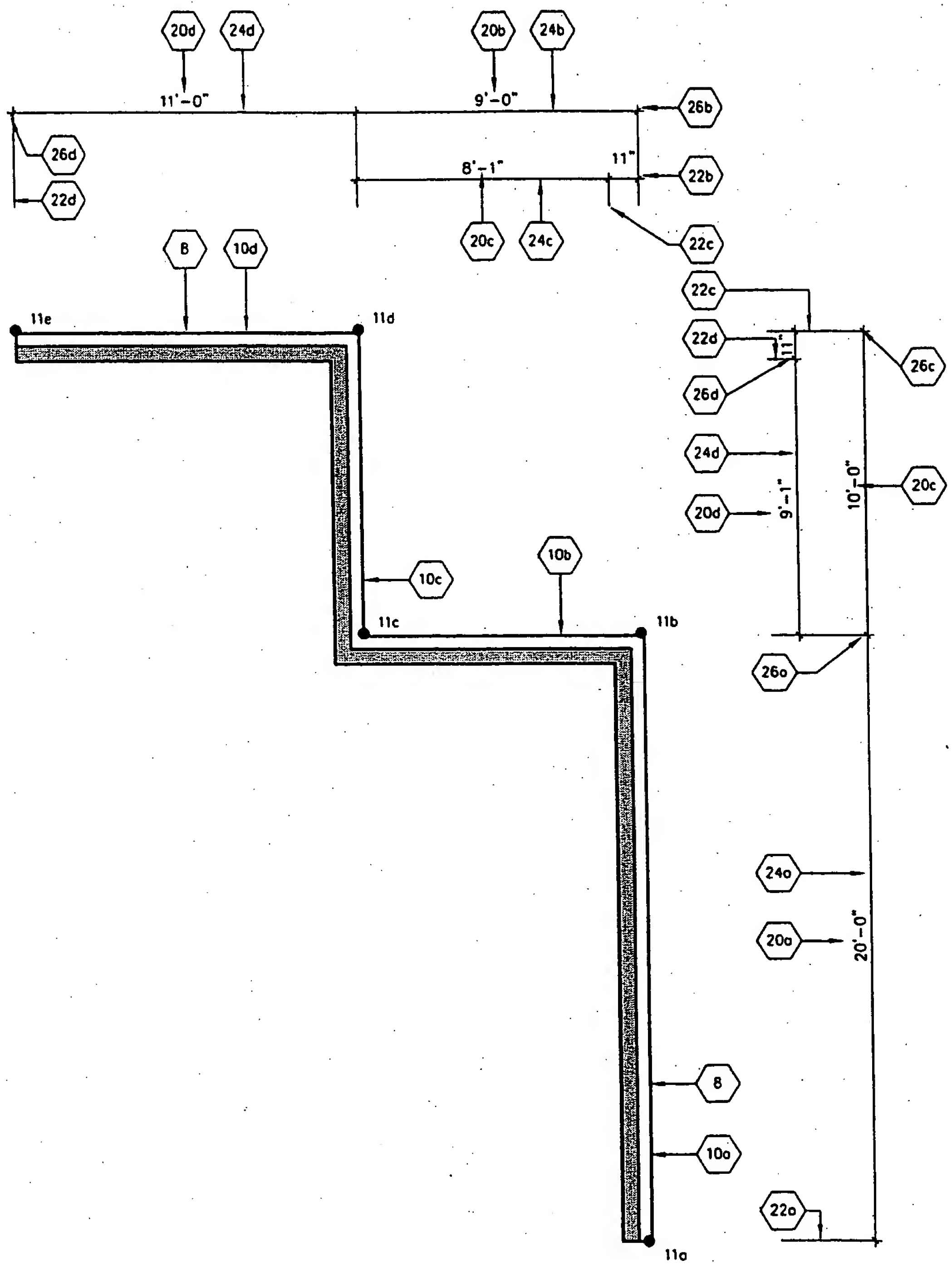

DIMENSION LINE 24b LOCATION BASED ON POINT 11c
20b
24b
9'-0"
26b
22b
8
10b
11c
11b
26a
24a
20a
20'-0"
10a
22a
11a

figure 3

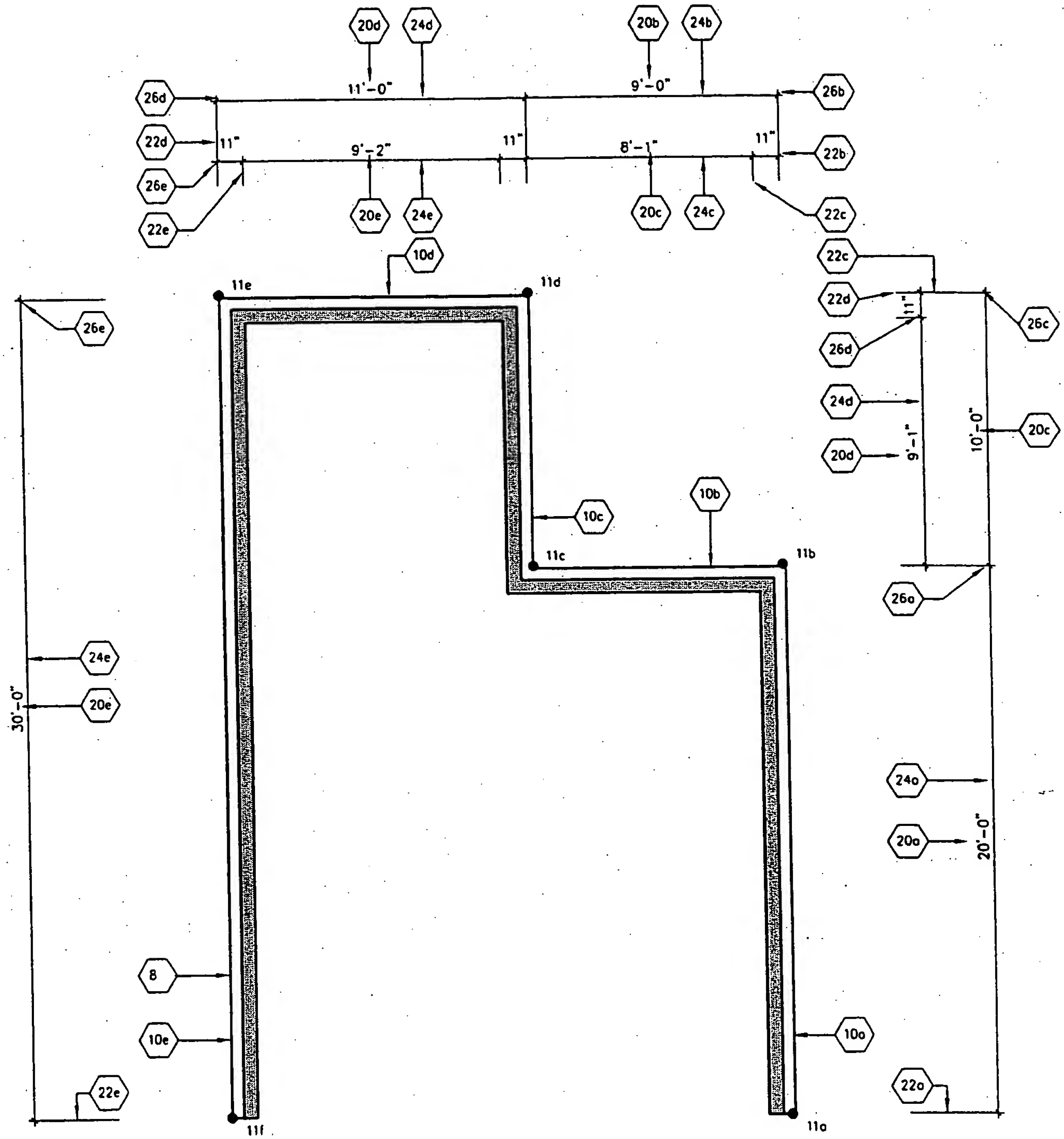

DIMENSION LINE 24c LOCATION BASED ON POINT 11d AUTOMATICALLY ADJUSTED TO MAINTAIN OFFSET DISTANCE
20b
24b
9'-0"
26b
11"
22b
8'-1"
20c
24c
22c
22c
11d
26c
20c
10'-0"
8
10b
10c
11b
11c
26a
24a
20a
20'-0"
8
10a
22a
11a

[illegible] 4



20d
24d
20b
24b
11'-0"
9'-0"
26b
26d
22d
8'-1"
11"
22b
20c
24c
22c
B
10d
22c
11e
11d
22d
11"
26c
26d
24d
20c
20d
9'-1"
10'-0"
10b
10c
11c
11b
26a
24a
20a
20'-0"
8
10a
22a
11a

figure 5



20d
24d
20b
24b
26d
11'-0"
9'-0"
26b
22d
11"
9'-2"
11"
8'-1"
11"
22b
26e
22e
20e
24e
20c
24c
22c
10d
22c
11e
11d
22d
11"
26c
26e
26d
24d
9'-1"
10'-0"
20c
20d
10b
10c
11c
11b
26a
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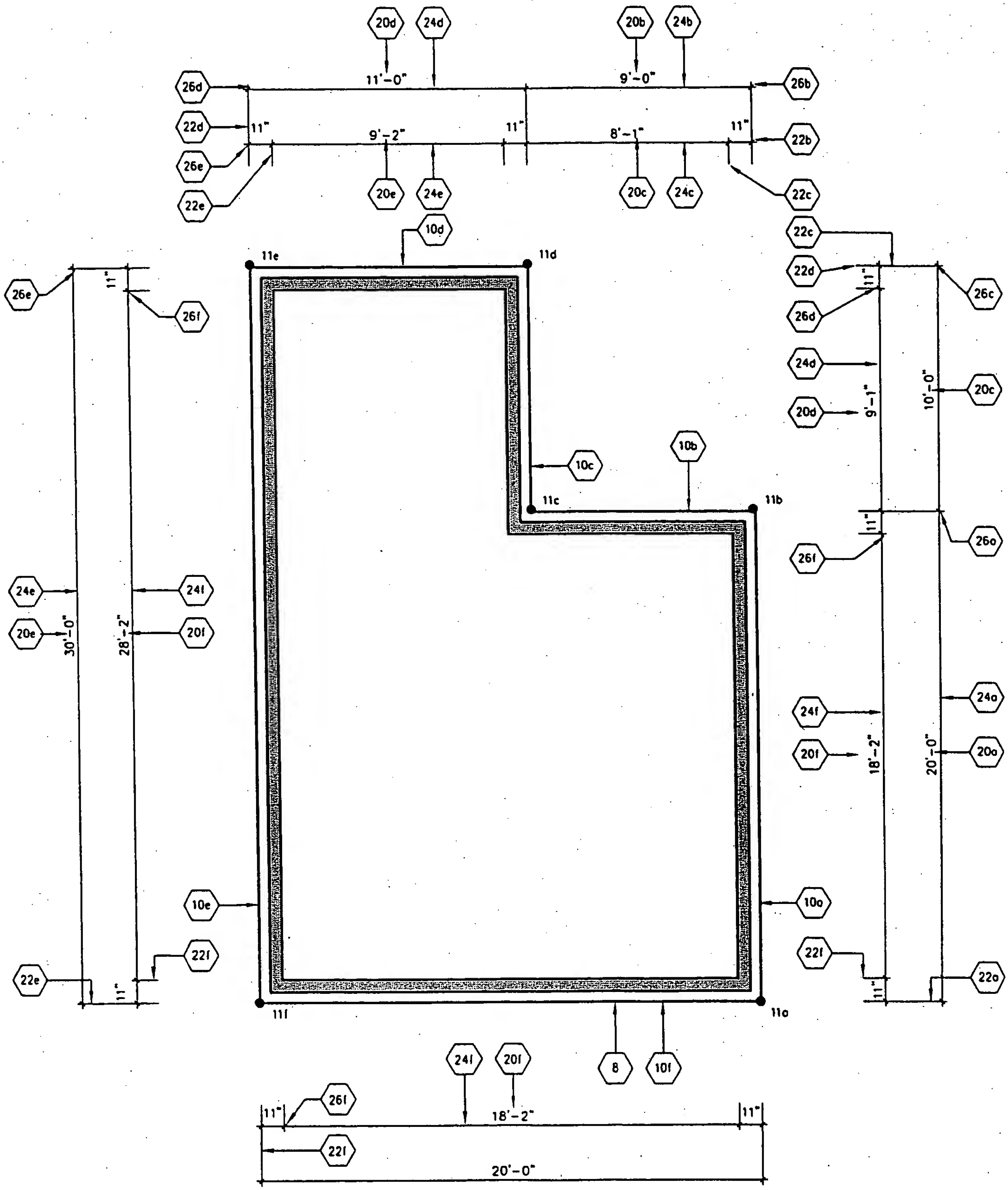
20'-0"
8
10e
10a
22e
22a
11f
11a


20d
24d
20b
24b
26d
26b
11'-0"
9'-0"
22d
22b
11"
9'-2"
11"
8'-1"
11"
26e
22e
20e
24e
20c
24c
22c
10d
11e
11d
26e
26f
22c
22d
26c
26d
24d
20c
20d
10'-0"
9'-1"
10c
10b
11c
11b
26a
26f
24e
24f
20e
20f
30'-0"
28'-2"
24f
24a
20f
20a
18'-2"
20'-0"
10e
10a
22f
22f
22e
22a
11f
11a
24f
20f
8
10f
26f
18'-2"
22f
20'-0"
figure 7

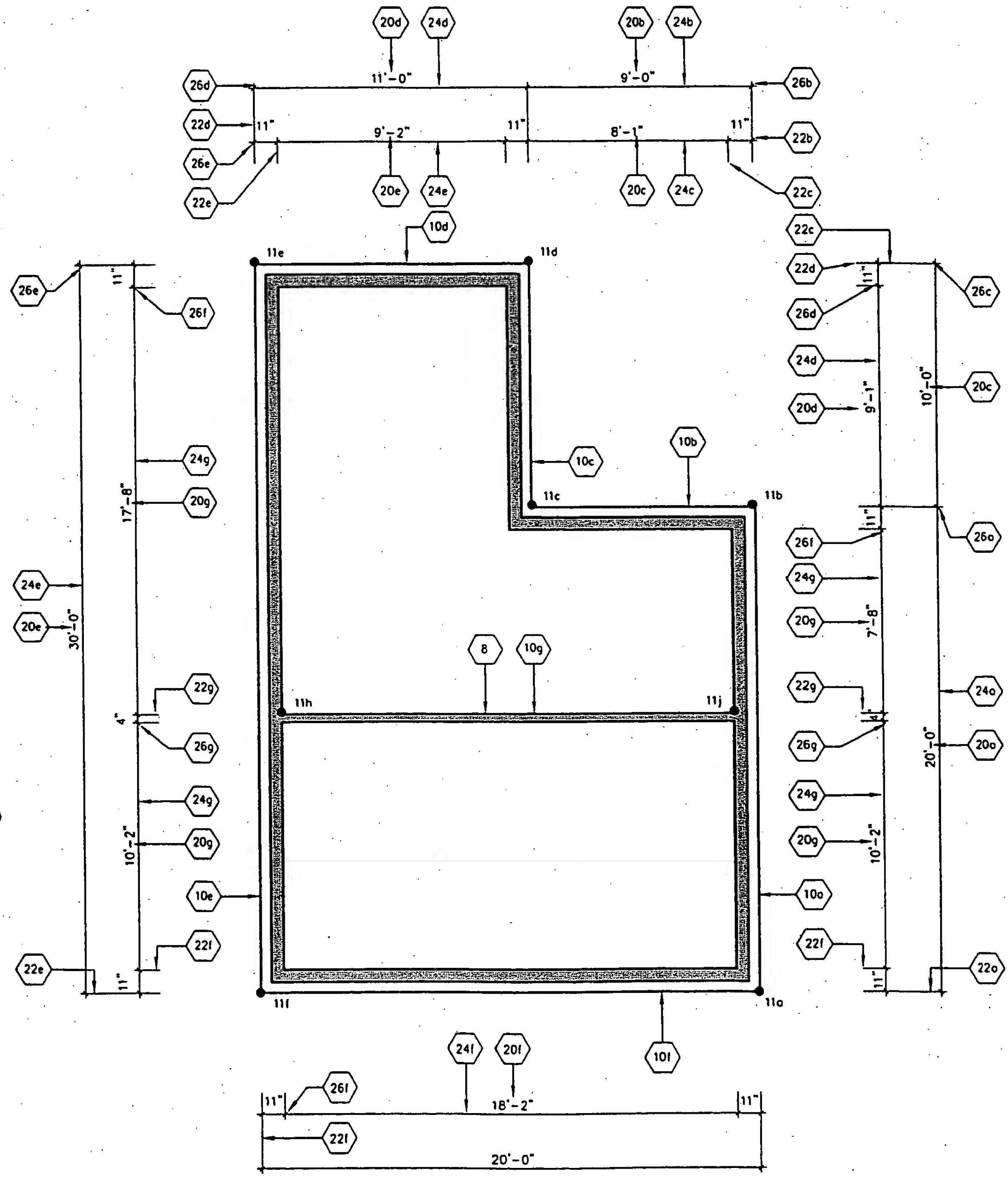

20d
24d
20b
24b
26d
11'-0"
9'-0"
26b
22d
11"
11"
11"
22b
26e
9'-2"
8'-1"
22e
20e
24e
20c
24c
22c
10d
11e
11d
22c
22d
26e
11"
26c
26f
26d
24d
20c
20d
9'-1"
10'-0"
10c
10b
24g
17'-8"
20g
11c
11b
26f
26a
24e
24g
20e
30'-0"
20g
7'-8"
8
10g
22g
22g
24a
11h
11j
4"
4"
26g
26g
20a
20'-0"
24g
24g
20g
20g
10'-2"
10'-2"
10e
10a
22f
22f
22e
22a
11"
11"
11f
11a
24f
20f
10f
26f
11"
18'-2"
11"
22f
20'-0"

figure 8

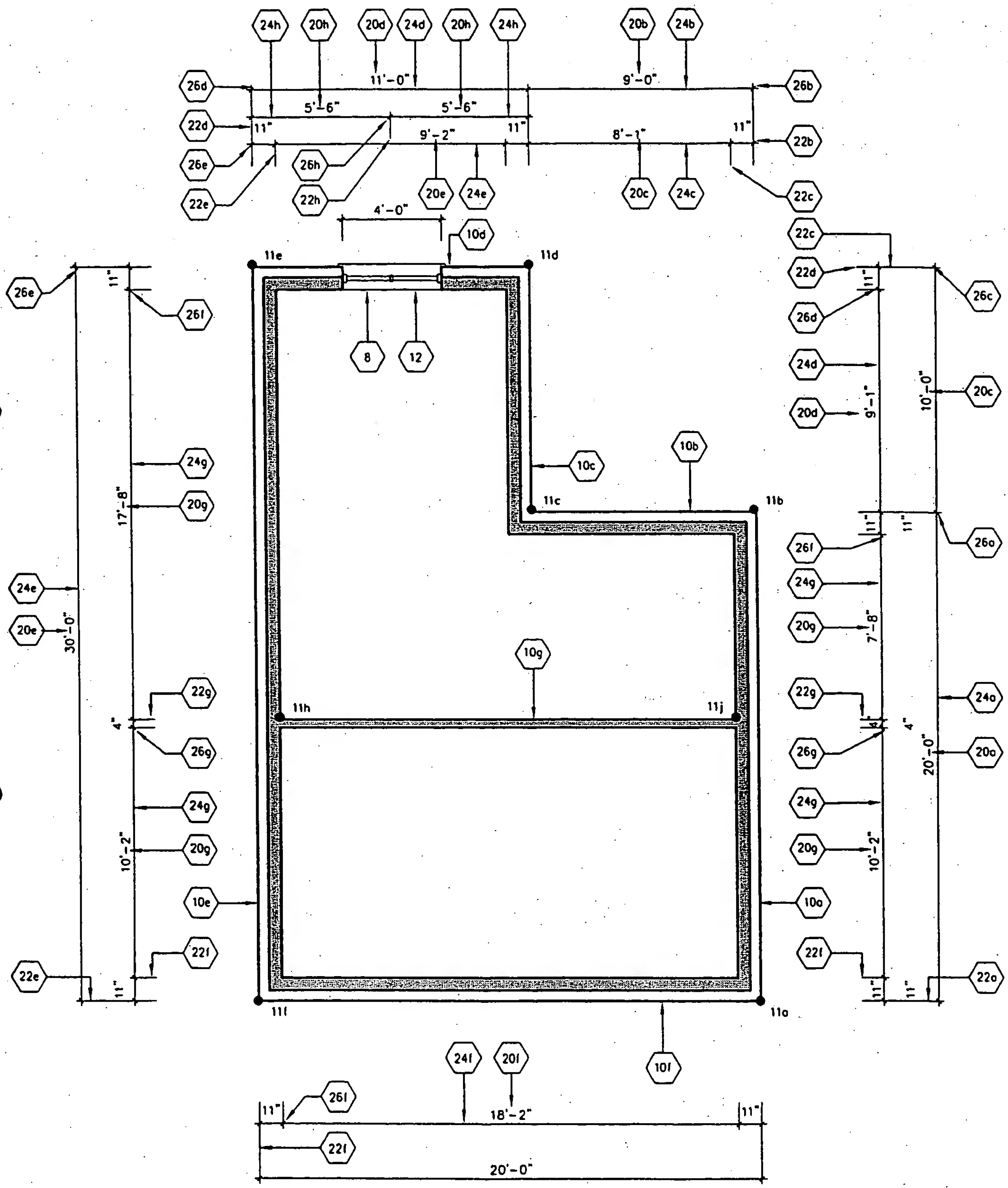
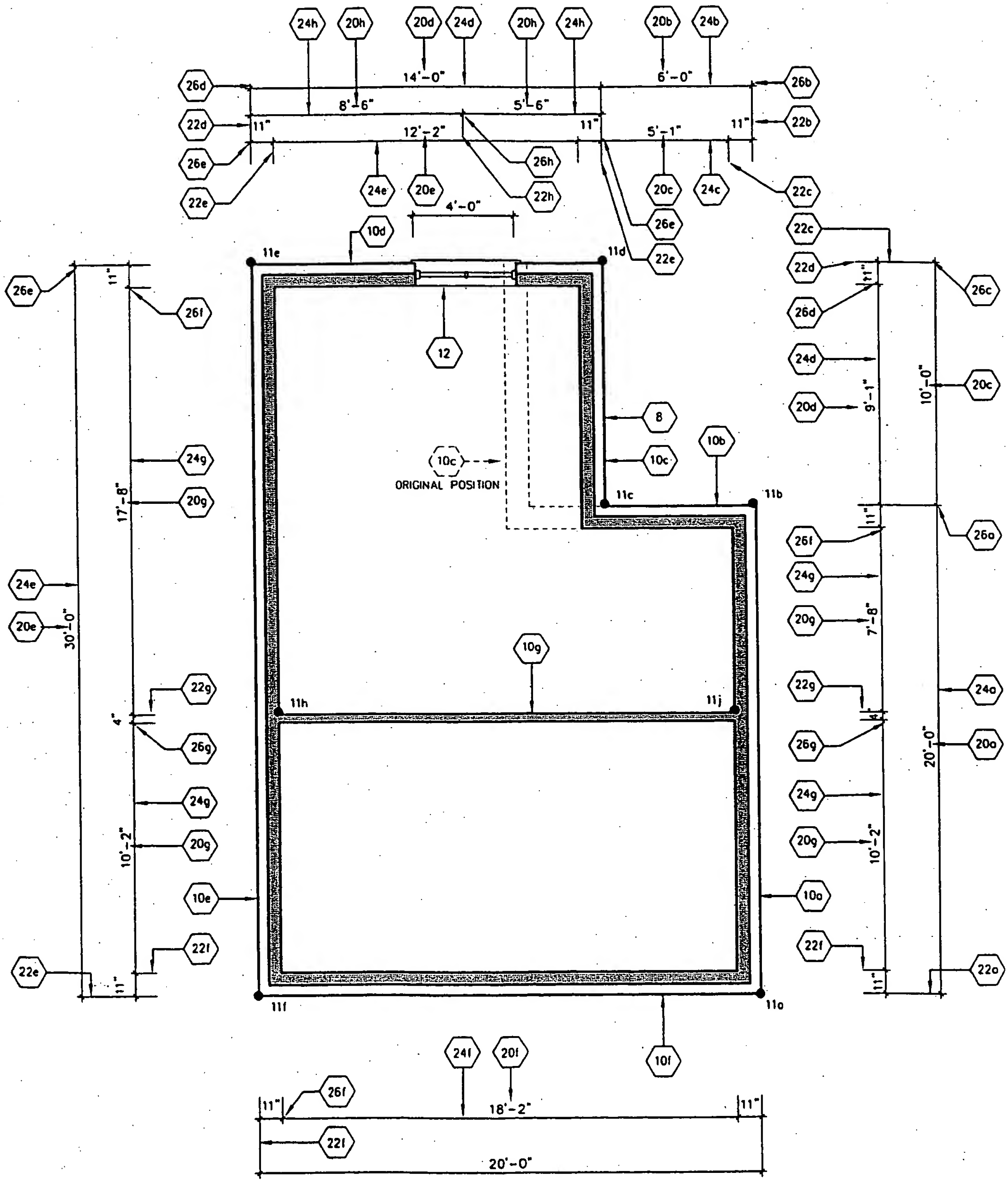

24h
20h
20d
24d
20h
24h
20b
24b
26d
26b
11'-0"
9'-0"
5'-6"
5'-6"
22d
11"
11"
11"
22b
9'-2"
8'-1"
26e
26h
20e
24e
20c
24c
22c
22e
22h
4'-0"
10d
22c
11e
11d
22d
26e
11"
26c
26f
26d
8
12
24d
20c
10'-0"
9'-1"
20d
24g
10c
10b
17'-8"
20g
11c
11b
11"
11"
26a
26f
24g
24e
20e
30'-0"
20g
7'-8"
10g
22g
22g
11h
11j
4"
4"
24a
26g
26g
20a
20'-0"
24g
24g
20g
20g
10'-2"
10'-2"
10e
10a
22f
22f
22e
22a
11"
11"
11"
11"
11f
11a
24f
20f
10f
26f
11"
18'-2"
11"
22f
20'-0"

figure 9



24h
20h
20d
24d
20h
24h
20b
24b
14'-0"
6'-0"
26d
26b
8'-6"
5'-6"
22d
11"
11"
11"
22b
12'-2"
5'-1"
26e
26h
22e
24e
20e
22h
20c
24c
22c
4'-0"
10d
26e
22c
11e
11d
22e
22d
26e
26f
26c
26d
12
24d
20d
9'-1"
10'-0"
20c
8
10b
10c
10c
ORIGINAL POSITION
11c
11b
24g
17'-8"
20g
26a
26f
24e
24g
20e
30'-0"
20g
7'-8"
10g
22g
22g
11h
11j
4"
26g
26g
24a
20a
20'-0"
24g
24g
10'-2"
20g
20g
10'-2"
10e
10a
22f
22f
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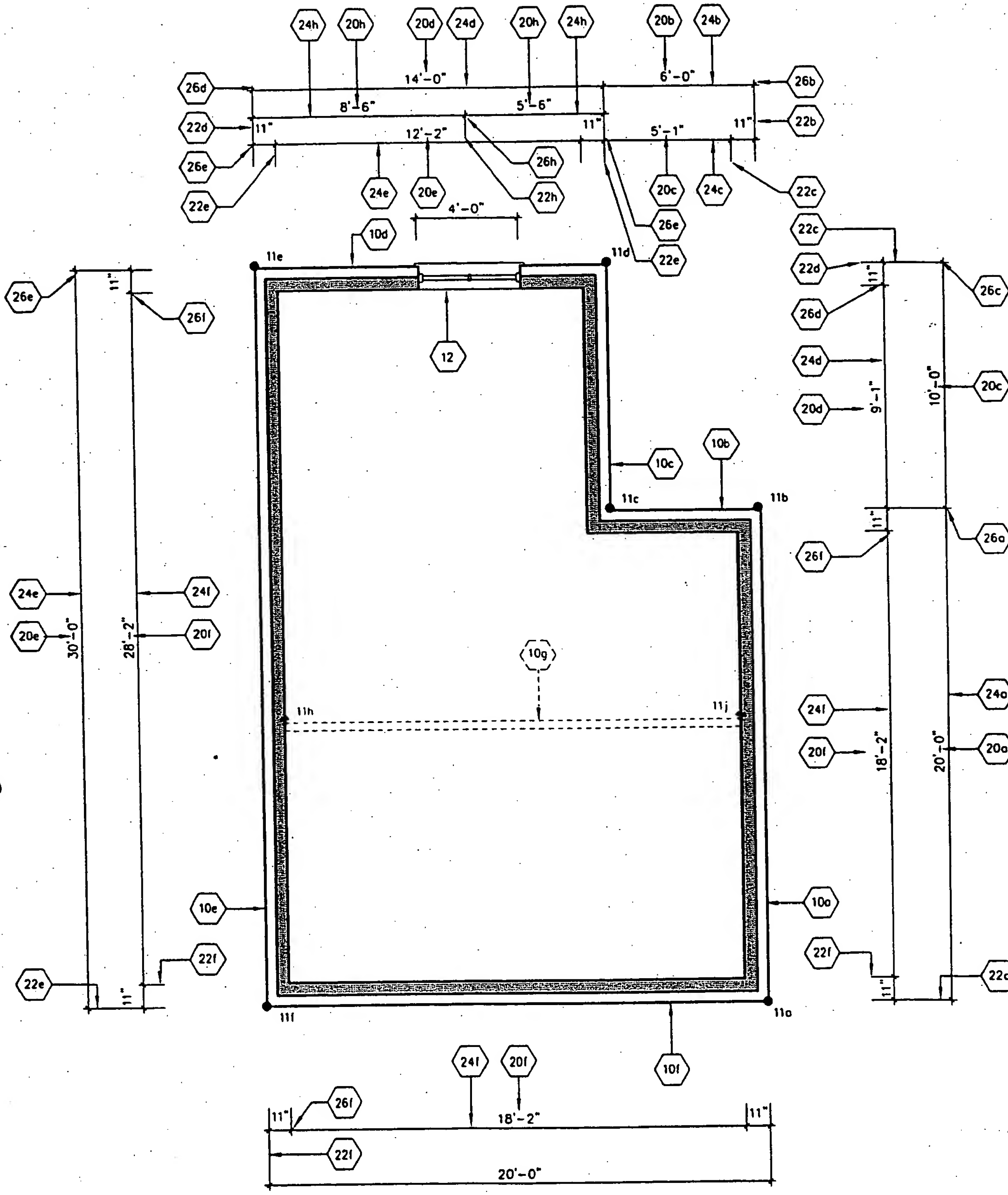
20f
10f
26f
11"
18'-2"
11"
22f
20'-0"



24h
20h
20d
24d
20h
24h
20b
24b
26d
14'-0"
6'-0"
26b
8'-6"
5'-6"
22d
11"
11"
11"
22b
12'-2"
5'-1"
26h
26e
22c
22e
24e
20e
22h
20c
24c
4'-0"
26e
22c
10d
11e
11d
22e
22d
26c
26e
11"
26f
26d
12
24d
10'-0"
20c
20d
9'-1"
10c
10b
11c
11b
11"
26a
26f
24e
24f
20e
30'-0"
28'-2"
20f
10g
11h
11j
24f
24a
20f
18'-2"
20'-0"
20a
10e
10a
22f
22f
22e
11"
11"
22a
11f
11a
24f
20f
10f
26f
11"
18'-2"
11"
22f
20'-0"

SCHEDULE "C"

7. A method for creating a computer aided design drawing formed of a plurality of target objects, comprising the steps of:

(a) inputting first coordinate position data;

(b) displaying a first target object corresponding to the first coordinate position data;

(c) creating first dimension annotation data correlated to the first coordinate position data;

(d) displaying a first dimension annotation correlated to the first dimension annotation data; and

(e) cross-associating the first target object with the first dimension annotation, wherein as a result of such cross-association:

(i) a change in the first coordinate position data will effect a correlated change in the first dimension annotation data; and

(ii) a change in the first dimension annotation data will effect a correlated change in the first coordinate position data.

8. The method of claim 7 further comprising the steps of:

(f) subsequent to step (e), inputting further coordinate position data corresponding to at least one further target object;

(g) displaying the further target object in accordance with the further coordinate position data;

(h) creating further dimension annotation data correlated to the further coordinate position data;

(i) displaying a further dimension annotation correlated to the further dimension annotation data

(j) cross-associating the at least one further target object with the further dimension annotation, wherein as a result of such cross-association:

(i) a change in the further coordinate position data will effect a correlated change in the further dimension annotation data; and

(ii) a change in the further dimension annotation data will effect a correlated change in the further coordinate position data;

9. The method of claim 8, further comprising the steps of:

(k) determining if the at least one further target object intersects the first target object

(l) wherein if the at least one further target object intersects the first target object into a first segment and a second segment:

(i) calculating first segment coordinate position data;

(ii) calculating second segment coordinate position data;

(iii) creating first segment dimension annotation data correlated to the first segment coordinate position data;

(iv) displaying a first segment dimension annotation correlated to the first segment annotation data;

(v) creating second segment dimension annotation data correlated to the second segment coordinate position data;

(vi) displaying a second segment dimension annotation correlated to the second segment annotation data;

(vii) cross-associating the first segment with the first segment dimension annotation; and

(viii) cross-associating the second segment with the second segment dimension annotation.

10. The method of claim 8, further comprising the steps of:

(m) determining if the at least one further target object is adjacent to any other target object.

11. The method of claim 10, further comprising the steps of:

(n) inputting modifications to the further coordinate position data;

(o) displaying the further target object in accordance with the modified further coordinate position data;

(p) creating modified further dimension annotation data correlated to the modified further coordinate position data; and

(q) displaying a modified further dimension annotation correlated to the further dimension annotation data.

12. The method of claim 11, further comprising the steps of:

(r) if the at least one further target object is adjacent to the first target object:

(i) modifying the first coordinate position data in correlation to the modified further coordinate position data;

(ii) displaying the first target object in accordance with the modified first coordinate position data;

(iii) modifying the first dimension annotation data correlated to the modified first coordinate position data;

(iv) displaying a first dimension annotation correlated to the modified first dimension annotation data

13. A method for creating a computer aided design drawing formed of a plurality of target objects, comprising the steps of:

(a) inputting coordinate position data for a new target object;

(b) displaying the new target object corresponding to the coordinate position data;

(c) creating dimension annotation data correlated to the coordinate position data;

(d) displaying a dimension annotation correlated to the dimension annotation data;

(e) cross-associating the new target object with the dimension annotation, wherein in said cross-association:

(i) a change in the coordinate position data will effect a correlated change in the dimension annotation data; and

(ii) a change in the dimension annotation data will effect a correlated change in the coordinate position data;

(f) repeating steps (a) through (e) for at least one additional target object;

(g) wherein all of steps (a) through (e) are completed for one target object prior to inputting coordinate position data for any additional target object.

14. The method of claim 13, wherein step (a) further comprises the steps of:

(h) determining whether the new target object intersects any other target object; and

(i) wherein if the new target object intersects at least one other target object so as to create a first segment and a second segment:

(i) calculating first segment coordinate position data,

(ii) calculating second segment coordinate position data,

(iii) creating first segment dimension annotation data correlated to the first segment coordinate position data,

(iv) displaying a first segment dimension annotation correlated to the first segment annotation data,

(v) creating second segment dimension annotation data correlated to the second segment coordinate position data,

(vi) displaying a second segment dimension annotation correlated to the second segment annotation data,

(vii) cross-associating the first segment with the first segment dimension annotation, and

(viii) cross-associating the second segment with the second segment dimension annotation.

15. The method of claim 13, further comprising the step of:

(j) determining if the new target object is adjacent to any other target object.

16. The method of claim 15, further comprising the steps of:

(k) selecting a target object;

(l) inputting modified coordinate position data for the selected target object;

(m) displaying the selected target object in accordance with the modified coordinate position data;

(n) modifying the dimension annotation data corresponding to the selected target object, the modification correlated to the modified coordinate position data; and

(o) displaying a modified dimension annotation correlated to the modified dimension annotation data.

17. The method of claim 16, further comprising the steps of:

(p) if the selected target object is adjacent to at least one other adjacent target object:

(i) adjusting the coordinate position data corresponding to the adjacent target object, wherein the adjustment is correlated to the modified coordinate position data;

(ii) displaying the adjacent target object in accordance with the adjusted coordinate position data;

(iii) adjusting the dimension annotation data corresponding to the adjacent target object, wherein the adjustment is correlated to the adjusted coordinate position data; and

(iv) displaying a dimension annotation correlated to the adjusted dimension annotation data.

18. The method of claim 13, wherein step (a) further comprises the steps of:

(q) determining whether the new target object superposes any other underlying target object; and

(r) wherein if the new target object superposes an underlying target object:

(i) creating at least one on-center dimension annotation data correlated to both the coordinate position data of the new target object and the coordinate position data of the underlying target object,

(ii) displaying an on-center dimension annotation correlated to the on-center annotation data,

(iii) cross-associating the new target object with the on-center dimension annotation, and

(iv) cross-associating the underlying target object with the on-center dimension annotation.